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## Introduction

**Summary of research objectives:** For lethal scenarios requiring rapid airway management, control of life-threatening hemorrhage and treatment of tension pneumothorax, this project had two principle objectives:

1. Assess training outcomes and durability of initial training of Combat Field Medics (CFM) with the 68-W designation by measuring performance of newly trained and experienced combat medics in performance during simulation-based scenarios focused on successful treatment using three skills: placement of combat application tourniquet (CAT) for exsanguinating leg injury, needle decompression of tension pneumothorax and placement of an airway device in a compromised airway.
2. Measure the effects of experience and demographics on performance.

**Rationale and background:** CFM training is a critical need of the United States Army. The 68W (formerly 91W) program at Fort Sam Houston (FSH), Army Medical Department (AMEDD), Department of Combat Medic Training (DCMT), trains over 7,000 CFM per year. Consolidation of medic training in the armed services has put increased demands on the training program at the DCMT at FSH. Efficiency and effectiveness of training are important goals that undergo continuous evaluation by the leadership structure of the DCMT.

Evaluation by DCMT to improve training identified two broad categories of student mistakes: first, mistakes of execution; the “how to” process and second, “What to do?” mistakes; involving cognitive / critical thinking skills. In order to improve training DCMT developed and conducts a two phase 16 week 91W CFM initial training curriculum, outlined below as a framework for training of necessary skills and knowledge.

- 6 weeks of foundation training; Emergency Medical Technician requirements
- 10 weeks of “Whiskey” (paramedic type) training covering:
  - Limited Primary Care / Invasive skills training / Field skills / Combat Trauma Management / Health Protection / Evacuation
  - Critical thinking skills required for battlefield triage

Advanced medical refresher training is conducted for experienced medics as one component of the Advanced Leadership Course (ALC), previously known as the army Medic Basic Noncommissioned Officer Course (BNOC) program. Medics participate at varying intervals following primary medic (68W) training, depending on their personal cycles of assignments, promotion considerations and other factors. Typically this course is completed 2-6 years following initial medic training.

DCMT transforms Soldiers, often without prior medical training, in 16 weeks, into fully qualified Combat Medics. Combat Medics are expected to treat multiple trauma victims,

often alone, under austere circumstances and often soon after graduation. Treatments can be simple or complex (i.e. hemorrhage, airway control). The curriculum includes classroom, field and hands-on training. Competency is assessed with standardized strategies using direct observation of skills performance using checklists and knowledge assessment with multiple choice question written examinations.

In order to save lives on battlefields, in humanitarian contingencies and disasters, the DCMT uses simulation training methodologies to allow students to move from abstract to authentic concepts and become a legitimate participant in medical care. Simulation enhances the Army's ability to provide standardized training to the Combat Medics. Simulation-based training methods permit rapid adaptation and incorporation of lessons learned to ensure that deploying medics have the best chance of success in the field.

Simulation-based training has been incorporated into the DCMT programs to address a variety of shortcomings that would likely improve with hands-on training. This was important since the 91W could be called on to perform in a combat or emergency situation with little or no supervision. Initially DCMT attempted to add more clinical training, but the reality of putting over 5000 students through Brooke Army Medical Center (BAMC) each year was that the students would only be exposed to vital signs, place IV's and perhaps observe trauma. Students would not have the opportunity to perform relatively rare procedures, such as placement of a tourniquet, needle decompression of pneumothorax, place an airway device, or manage critical patients. Simulation was introduced as one component of the solution to identified training deficiencies.

Medical simulation has been incorporated into the primary training curriculum of the DCMT since November 2002. Micro-simulation (computer simulation) and macro-simulation (full-scale simulation) is used for medical skill acquisition, performance enhancement, diminishing skill decay and quantitative performance and program evaluation.

Micro-simulation works well for critical thinking and cognitive training (the "what to do"), however, it is less suitable for team training or psychomotor skills. To address the "how to" issues, DCMT uses macro-simulation. Macro-simulation requires the student to interact with a manikin or other large model. Macro-simulation includes computerized human patient simulators, and DCMT also employs simulation with task trainers, human actors, mannequins and vehicular mock ups.

The capstone event in primary medic training is a tactical demonstration in a field testing exercise (FTX) at Camp Bullis (CB). The FTX uses macro-simulators in this "final exam." The FTX tests skills taught in the prior 15 weeks of intensive initial combat medic curriculum. The FTX, on a small scale, provides physical and psychological stressors to mimic combat environments that degrade performance. Instructors evaluate care provided by the students at point of wounding, during triage, emergency resuscitation and care until the medic relinquishes the patient to other medical personnel.

Historically, up to 90% of combat deaths occur before a casualty reaches a hospital. Analysis of lethal injury patterns reveals that exsanguination from extremity wounds (9% of KIA) tension pneumothorax (5%) and airway obstruction (1%) from contemporary conflicts have revealed that point of injury care focused on correct placement of a tourniquet, immediate needle decompression of tension pneumothorax and airway device placement may save between 70-90% of preventable deaths on the battlefield. Incorporation of point of injury early resuscitation skills in primary medic training using simulation methods for early tourniquet placement, needle decompression of tension pneumothorax and airway device placement management has been one contributor to current conflict wounded soldier case fatality rates of 11%, the lowest combat mortality rates seen in the history of American military medicine.

The Combat Medic is the base on which the military medical system is built. The 91W functions in the military medical system as a first responder, trauma team member, physician extender, often initiating treatment independently.

Standardized training regimens are established, published and deployed according to US Army procedures. To ensure a continuous quality improvement implementation strategy, training center leaders require feedback on the type of training needed by CFM trainees. They are also in need of information concerning how best to revise the curriculum to continually meet a high state of readiness to support the Army's medical mission. Additionally, it is beneficial to understand how a soldier's previous experience influences performance of critical skills. There is a need for formalized assessment of CFM skills retention and investigation of the ideal method of retraining, taking into account previous experience.

Modern armed conflicts have generated an enhanced understanding of lethal injuries and identification targets for training to decrease the number of preventable combat deaths through immediate resuscitation. Three specific potentially survivable injuries have been identified for which enhanced application of field resuscitation may account for prevention for 85% of preventable deaths. The resuscitation techniques for these injuries are acute hemorrhage, tension pneumothorax and airway.

**Study Overview:** Data collection and research objectives were addressed in two phases:

***Phase I*** involved collection of data representing a baseline evaluation of skills performance on three combat trauma scenarios for inexperienced CFM trainees undergoing initial training at the DCMT. For this data set 399 CFM skills performance was assessed at Camp Bullis, San Antonio, TX (CB) between November 2009 and August 2010, in the final weeks of training.

This phase was designed to evaluate the effectiveness of initial combat medic training in performance of three lifesaving clinical intervention skills; Tourniquet application for exsanguinating limb hemorrhage, airway placement for a compromised airway and needle decompression of tension pneumothorax.

**Phase II** involved collection of data representing evaluation of the same skills performance as Phase I in experienced CFM. These medics were evaluated during an advanced Army course for leadership skills and clinical refresher training following one or more assignments following initial combat medic training. For this data set, 205 CFM skills performance was assessed at FSH, San Antonio, TX between March 2010 and October 2011.

This cohort was randomized to three groups each of which underwent a unique retraining curriculum prior to skills assessment:

1. A control group which underwent the standard combat medic retraining curriculum
2. A group exposed to standard combat medic retraining curriculum, plus skill specific instructional video viewing
3. A group exposed to standard combat medic retraining curriculum, plus skill specific instructional video viewing, plus hands-on practice with human-patient simulators.

This phase was designed to compare experienced medic combat medic skills to newly trained combat medic skills the in performance of three lifesaving clinical intervention skills: tourniquet application for exsanguinating limb hemorrhage, airway placement for a compromised airway and needle decompression of tension pneumothorax. This comparison was conducted to assess the durability of training and to examine potential impact of field experience on skills retention. The educational interventions described were designed to determine if different retraining paradigms resulted in improved performance of lifesaving clinical skills.



## **Body**

(See Appendix F for draft manuscript for submission to *Annals of Emergency Medicine*.)

### **Project Summary and Statement of Work**

#### *Year 1*

During Year 1 of the project, circumstances led to a number of significant changes to the scope of the project from the originally submitted proposal. Administratively, Dr. John Schaefer (Initial PI) left UPMC, and Dr. Paul Phrampus was named the new UPMC Principle Investigator for this award.

In September of 2005, Tom Dongilli of the Peter M. Winter Institute for Simulation Education and Research (WISER), on behalf of UPMC, visited the DCMT to review the operations of their simulation program. In conjunction with DCMT leadership several focus areas were identified for enhancement using the simulation expertise of WISER. Collaboration with DCMT leadership, combined with the results of the site visit, was used to identify the major obstacles facing the simulation program at the DCMT. The primary obstacle was the ability for DCMT personnel to enter the large amount of training paperwork into their computer systems during the post-training period, impeding accurate timely analysis of training outcomes. There was also a need for the development of additional simulation instruction modules.

In January 2006, the Operational Review was submitted to LTC Hernandez at the DCMT. Following several leadership and operational changes to the DCMT simulation program after the initial review, a second review of the DCMT simulation program was requested. This review took place on February 20 and 21, 2006.

Dr. Phrampus, Tom Dongilli and Tracee Gruber from WISER visited FSH to perform the second operational review, working with leadership from the DCMT to determine which areas could optimally benefit from UPMC and WISER simulation expertise. Paper based data collection and workflow were again identified areas of concern. DCMT leadership indicated that recent additions and modifications to the training curriculum eliminated the need for the development of the previously requested instruction modules.

UPMC provided the DCMT and TATRC with the second version of the Operational Review in March 2006. The second Operational Review highlighted several functional areas where UPMC could assist the DCMT. LTC David Hernandez and COL Patricia Hastings, DCMT leadership, reviewed the Operational Review document. It was determined that the comprehensive proposed program and recommendations were unlikely to be accomplished given the operational pace of training at DCMT and the potential impact of the recommended program on day to day operations. A revised study design was requested.

#### *Year 2*

A new study design was developed by Dr. Phrampus and Benjamin W. Berg MD COL USA (ret) with input from DCMT leadership and TATRC. The new study design extended the scope of the study to include evaluation of combat medics at the National Training Center (NTC) at Fort Irwin (FI) in addition to the cohort at FSH. FI participation was coordinated with NTC Surgeon COL Glorioso and his training staff. These ideas were the basis for the proposal, and in July 2006, a modified statement of work was submitted for the FY04 award. A continuation proposal was submitted to modify the award to add FY05 funding. These documents were reviewed and approved by the COR and an award modification was approved on September 29, 2006. Project foundation materials were created and baseline project plans were finalized for both funding years.

Dr. Phrampus presented the proposed projects/SOWs at the Advanced Technology Applications for Combat Casualty Care (ATACCC) conference in August 2006 in St. Pete Beach, FL. The project was received with a considerable positive response. Dr. Phrampus presented a project update at the TATRC product line review (PLR) meeting on March 6, 2007.

A Project Kick-Off Meeting took place at the NTC at FI on November 27, 2006. This meeting was attended by representatives from TATRC, FSH, FI, UPMC, WISER and the University of Hawaii. The purpose of the grant was explained to participants and the roles of each involved entity were detailed. Dr. Phrampus presented a high level project overview which was followed by a review of operations at the DCMT at FSH and the NTC at FI. Operational processes were identified for implementation of the proposed project. At the conclusion of the meeting, all representatives expressed that the project could yield significant information to be utilized to enhance Army combat medic training programs. Iterative project steps and a timeline were outlined. The methods planned for facilitating certain tasks within the Statement of Work required modification based on the results of the operational kick-off meeting discussions.

Two no-cost extensions were requested in FY06. One resulted in no changes to the statement of work (SOW) and an extension to October 2006. The other resulted in significant changes to the SOW and an extension to October 2007.

### *Year 3*

A number of leadership transitions occurred during Year 3 of the project. The US Army PI changed from COL Patricia Hastings to LTC Paul Mayer. LTC Mayer was deployed in 2008 and replaced by COL James Signaigo. On the UPMC side, Terri Collin, PhD, joined the project team in the statistical and research coordination role. Dr. Collin is an employee at the University of Pittsburgh.

A successful face-to-face meeting was held at FSH on July 17, 2007. During this visit, UPMC reviewed project details and goals with DCMT leadership. Based upon input from newly involved DCMT project team members, logistics were more clearly defined, based on the current DCMT workflow. During this meeting, DCMT leadership suggested that

the project simulation activities be conducted inside a customized trailer building and agreed provide this facility for project use. UPMC and DCMT leadership coordinated a plan for employment of on-site research personnel to conduct the study.

Ultimately a fixed space facility was utilized for the programs research activities. The change in the research facility provided at FSH delayed logistical planning for defined space requirements, network connectivity, storage and seating.

On March 5, 2008, COL Signaigo met the UPMC project team in Pittsburgh and toured the WISER facility. During this meeting, COL Signaigo suggested moving the Phase II study to FSH, from the previously agreed to site at FI, allowing for efficient concurrent Phase I and Phase II data collection. Equipment for Phase I was ordered and received in Pittsburgh.

#### *Year 4*

Another PI transition was made in 2008 when COL Signaigo retired in July, 2008. MAJ Robert Mabry was named the new Army PI.

The proposal and statement of work were modified based on the logistical changes and the modifications determined during the previous project year. This change relocated Phase II to FSH instead of FI. The project team created a new project plan and timeline.

Institutional Review Board (IRB) protocols were submitted to all participating institutions including the University of Pittsburgh, Brooke Army Medical Center (BAMC), US Army Clinical Investigation Research Office (CIRO) and the MRMC and Human Research Protection Office (HRPO). The Project completed materials for the data collection phase, based on submitted IRB protocols.

#### *Year 5*

A contract extension request with updated budgets was submitted on June 17, 2009, to extend the research until December 2010. The modification was approved on December 17, 2009.

By May 2009, the project protocol had been approved by the IRBs at the University of Pittsburgh, BAMC and HRPO.

Project management explored contracting of onsite staffing needs in San Antonio with the Henry M. Jackson Foundation (Rockville, MD) and the TRUE Research Foundation (San Antonio, TX). TRUE Research Foundation was selected to provide the research personnel to perform and monitor the data collection for Phase I and Phase II in San Antonio, TX. Two part-time personnel were hired with the job titles Combat Medic Research Facilitator Supervisor and Combat Medic Research Facilitator. TRUE Research Foundation had a master CRADA with CIRO and executed an addendum for

UPMC with respect to this project. Both research assistants trained at the WISER simulation center on software, data collection procedures and the Laerdal SimMan from October 5 through 9, 2009. In preparation for this class, UPMC completed research protocol related training materials for use by the TRUE employees.

Project team members completed a site visit to CB and FSH in June 2009 to survey the data collection sites and coordinate with base personnel. At CB, team members met with MAJ Jimmy Cooper and MAJ Charles Dean to coordinate trainee recruitment. The data collection site at CB was inspected. A private and secured tent was provided to the study for simulation exercise data collection at CB. MAJ Jimmy Cooper, CPT Patrick Williams and Chris Kwader met with project team members at FSH to coordinate recruitment and the simulation exercise data collection facility at FSH. A secure trailer was provided to the project for data collection at FSH, adjacent to the training facilities where study recruits are located during their DCMT training activities.

All required research equipment was shipped, installed and tested on-site by October 15, 2009 in San Antonio.

Testing of the curriculum was finalized in Pittsburgh for Phase I. Additional testing and training was conducted Oct 21-23, 2009 on-site. Dr. Terri Collin met with MAJ Mabry to discuss data collection and observing field training. Project team members ensured research equipment was operating. Mock research simulations and data collection were conducted and verified. Dr. Terri Collin observed the mock runs for assurance of data collection process integrity, as specified in simulation scripts and IRB protocols. Data collection for Phase I began November 2009.

The curriculum for Phase II was finalized and testing began in March, 2010.

Tom Dongilli presented a project update at the TATRC Product Line Review presentation on February 23, 2010.

#### *Year 6*

UPMC Project Manager, Paige Carroll, traveled to San Antonio May 17-19, 2010 for a FSH site visit and to observe Phase II data collection. Over the two days, Ms. Carroll was observed the performance of the two research facilitators who managed data collection and also observed a total of 16 subjects during research simulation exercises.

Harvey Magee and MAJ Brett Talbot (COR), TATRC, made a site visit to UPMC/WISER Pittsburgh on November 17, 2010. The project status was updated and future project tasks were identified. As one of the outcomes from TATRC during the site visit, a modification was prepared by UPMC and submitted on November 26, 2010. The modification was suggested and discussed by TATRC and UPMC in order to take advantage of the extensive dataset that was collected for Phase I and Phase II of the project.

A no-cost contract modification request was submitted and approved to re-budget, extend the period of performance to July 31, 2011 and to increase the scope of the data analysis. The extensive data set collected allowed advanced analysis to inform educational processes for simulation-based combat medic training. The additional analysis included inter-rater reliability measurements for skills assessment using video material from the project's FSH simulation videos and addition to correlation analyses performed on demographic and performance variables. The modification was approved in February 2011.

Due to current construction at Fort Sam Houston and reduction of DCMT storage space, Mr. Chris Kwader requested that the research project equipment be repatriated to UPMC. Mr. John Lutz traveled to FSH February 23-25 to inventory and coordinate shipping to WISER/UPMC. The equipment was used to validate data during the inter-rater reliability analysis in Pittsburgh.

### *Results of Inter-rater Reliability*

A comprehensive data analysis was completed as specified in the approved IRB protocols. There were a total of 399 participants for Phase I and 205 participants for Phase II. The research findings and results are presented in a draft manuscript prepared for submission to the Annals of Emergency Medicine (Appendix F).

Review of 142 randomly selected scenario performance videos was completed by reviewers who reported time to completion of the key clinical task (tourniquet application, securing of the airway, or needle decompression of pneumothorax), and the total number of predefined specific steps required to complete the skill. These two parameters were identical to the parameters reported by the direct observers who collected data during the real-time scenario performance during protocol Phase I and Phase II. The inter-rater reliability observers were 1 paramedic who had not observed any prior videos or actual live simulation scenario performance by study subjects; and 1 of the "original" research assistants who had collected primary protocol data during live scenario exercises. There was a time interval of >5 months between the "original" observer's primary observation and data collection during live scenario performance by study subjects and the inter-rater reliability video review exercise. All inter-rater reliability observers were provided identical instruction in regarding video viewing, parameter measurement and reporting for the two measured parameters.

| Scenario     | Parameter  | N  | Mean $\pm$ SD     | 95% CI      | Chronbach's Alpha |
|--------------|------------|----|-------------------|-------------|-------------------|
| Airway       | Time (sec) | 48 | 255.2 $\pm$ 92.1  | 221.4-289   | 0.97              |
| Airway       | Steps (#)  | 48 | 13.59 $\pm$ 4.59  | 11.9-15.26  | 0.88              |
| Hemorrhage   | Time(sec)  | 47 | 80.25 $\pm$ 29.24 | 71.89-88.61 | 0.85              |
| Hemorrhage   | Steps (#)  | 47 | 8.82 $\pm$ 2.96   | 7.98-9.67   | 0.48              |
| Pneumothorax | Time (sec) | 47 | 187.1 $\pm$ 67.28 | 167.9-206.4 | 0.96              |
| Pneumothorax | Steps (#)  | 47 | 14.79 $\pm$ 3.88  | 13.68-15.91 | 0.73              |

A Chronbach's alpha coefficient of  $\geq 0.70$  is generally considered an acceptable reliability coefficient. The results suggest acceptable inter-rater reliability except in the counting of steps for the hemorrhage scenario. The hemorrhage scenario was generally completed in a much shorter time than the other two scenarios and had fewer steps counted on average. The shorter scenario time for hemorrhage scenarios may have allowed less time for accurate counting of sequential steps, likely accounting for the lack of inter-rater reliability in this scenario when reviewed by similarly trained reviewers. A larger number of video reviews is required to determine if this finding is sustained.

### *Summary of Contract and Modifications*

Original Contract Dated 04/01/05

- Period of Performance (POP) - 04/01/05 – 11/30/05
- 

Modification 1

- Extend the POP - 04/01/05 – 11/30/06

Modification 2

- Change the UPMC PI from Dr. Schaefer to Dr. Phrampus

Modification 3

- Added additional funds from FY05 funding
- Total funds:)
- POP extended - 04/01/05 – 10/28/08

Modification 4

- Extend the POP - 04/01/05 – 08/31/09

Modification 5

- Extend the POP - 04/01/05 – 12/31/10
- Revise budget
- Reduce total award by \$10,000

Modification 6

- Extend the POP – 4/01/05 – 7/31/11
- Revise proposal to include additional analysis
- Revise budget

## STATEMENT OF WORK (SOW) SUMMARY

| Tasks  | Status    | Documentation (as appropriate)      |
|--|-----------|-------------------------------------|
| <b>Milestone: Protocol and CRADA submission</b><br>1. Submit protocol to UPMC/University of Pittsburgh Institutional Review Board (IRB)<br>2. Submit protocol and CRADA to Fort Sam Houston (FSH) IRB<br>3. Submit to Ft. Detrick          | Completed |                                     |
| <b>Milestone: Statistical analysis planning</b><br>1. Review planned data metrics and data gathering tools   | Completed |                                     |
| <b>Milestone: Hardware preparation and software development</b><br>1. Test hardware at UPMC and pack for transfer to FSH<br>2. Design and test prototype upload tool<br>3. Design data reports<br>4. Program and test simulation scenarios | Completed | Appendix A<br>(Equipment inventory) |
| <b>Milestone: Protocol and CRADA approval</b><br>1. Protocol approval by UPMC/Pitt IRB<br>2. Protocol approval by FSH IRB<br>3. CRADA approval by CIRO<br>4. Protocol approval by Ft. Detrick  | Completed |                                     |
| <b>Milestone: Hiring of staff</b><br>1. Determine staff requirements<br>2. Hire on-site personnel  | Completed | Appendix B<br>(CVs of on-site team) |



| Tasks   | Status                    | Documentation (as appropriate)  |
|---|---------------------------|---|
| Milestone: On-site pre-data collection work<br>1. Ship equipment to FSH<br>2. Installation of hardware and software at FSH<br>3. Train on-site personnel<br>4. Test collection of data at simulation stations<br>5. Test upload tool at FSH | Completed                 | Appendix C<br>(Instruction materials for on-site team)                                  |
| Milestone: On-site data collection<br>1. Perform evaluations at simulation stations<br>2. Monitor evaluations via observation and data integrity analysis   | Completed                 | Appendix D<br>(Assessments Checklist)   |
| Milestone: SIMS reporting and data analysis<br>1. Analyze data on a regular basis<br>2. QA test data integrity on a regular basis<br>3. Provide standard and custom reports to FSH leadership   | Completed                 | Appendix E (Product Line Review Presentation)   |
| Milestone: Project reporting<br>1. Submit quarterly and annual as required by the contract  | Completed                 | (See previous quarterly reports submitted.)   |
| Milestone: Final results reporting<br>1. Perform comprehensive data analysis<br>2. Prepare final report and make recommendations<br>3. Meet to present final report<br>4. Perform “project close” procedure                                 | Project Close in process. | Appendix F<br>(Draft manuscript for submission to <i>Annals of Emergency Medicine</i> ) |

## **Key Research Accomplishments**

### ***Administrative and Logistical***

- Completion of a large multi-institutional research study within the allotted budget, despite setbacks and changes to DCMT leadership and priorities. Although for various reasons there were significant delays in the initiation of the project, the research team was flexible enough to reconfigure and complete its work to match new military priorities.
- Seamlessly completing research while avoiding disruption of ongoing training operations at CB and FSH/DCMT in the course of a research project that spanned six years, 804 volunteer test subjects and multiple leadership teams.
- Securing IRB and other approvals from the University of Pittsburgh, the Brooke BAMC and the Army ORP HRPO.
- Establishing and later disassembling fully equipped research simulation-based test stations at FSH.
- Recruiting and training on-site research facilitators with previous CFM experience to collect data, score trainee performance and liaise with local military partners.
- Coordinating contributions of research team members and administrators from Pittsburgh, Honolulu, and San Antonio at a range of institutions comprising the University of Pittsburgh, the University of Hawaii, DCMT, CB, FSH and the TRUE Research Foundation.

## **Key Research Accomplishments, continued**

### ***Research-related***

- Collecting a data set representing demographic and experience-related items and performance of 399 novice combat medics and 205 experienced medics on the three most common preventable lethal medical emergency scenarios encountered in modern combat trauma: airway compromise, life-threatening hemorrhage and tension pneumothorax.
- Completion of the first systematic external evaluation of the US Army DCMT competency outcomes using an independent evaluation strategy.
- Validation of the extant training paradigms at the DCMT using a rigorously defined evaluation paradigm for cognitive and psychomotor skills integration.
- Developing a software interface enabling integration and analysis of separate data streams from human-patient simulators, surveys and test subject performance tests.
- Using human-patient simulators as part of a system-wide approach to performance assessment for continuous quality improvement.
- Analyzing data with modern statistical techniques to determine the existence and strengths of relationships between and among variables such as demographic characteristics, experience and training interventions.
- Linking insights gained on military medical training approaches and modern research methods to gain knowledge on measuring and promoting high-level performance of trauma procedures.
- Advancing the state of both civilian and military research on lifesaving procedures, both through the direct experience of the research team and military collaborators and preparation of manuscripts for publication.

## **Reportable Outcomes**

See **Body** for outcomes and related documents linked to the Statement of Work, **Appendix F** for the draft *Annals of Emergency Medicine* article and **Conclusions** for a research team summary of the significance of its findings.

### ***Manuscripts and presentations***

A manuscript for submission to the *Annals of Emergency Medicine* is in the final stage of in-house review (see Appendix F). Additional manuscripts will be prepared to report for secondary findings.

To date no other presentations outside the Army have been conducted or requested on the research project.

No funding, employment, or additional research opportunities have been sought that are based on the work supported by the award.

The research team plans to seek funding, as available, for continued academic work on issues related to measuring and improving military and civilian trauma medicine training. The investigators have demonstrated expertise and leadership in using simulation-based training for the education of hospital system employees at all levels; medical, nursing, EMT and paramedic students; professionals for whom remediation or refresher courses are indicated or required; and staff training that promotes organizational quality control initiatives.

## Conclusions

A cohort of 604 US army medics, 399 in-training novices and 205 experienced medics were tested, using simulation-based clinical exercises to establish the proportion of participants who successfully completed three lifesaving emergency medical procedures commonly recognized as those with the greatest potential to increase survival and decrease the rate of preventable traumatic combat deaths: 1) airway restoration; 2) hemorrhage control; and 3) treatment of tension pneumothorax. The test results were collected and evaluated by an external independent academic university based educational research team to determine the extent to which the US Army Combat Medic Training Curriculum produces competent practitioners as defined by the DCMT standards. In addition the research program sought to identify demographic factors which could distinguish medics who met from medics who did not meet the training performance standards. Finally the project sought to compare the skill level of experienced medics to the skill performance of in-training novice medics. Two educational interventions were studied to determine the effect on skill performance by experienced medics who are undergoing refresher training. The table below summarizes the number of predefined clinical steps performed and the completion times recorded for each of the procedural skills examined in this study. The discussion below offers possible explanations for the findings, observations from the on-site team and implications for the advanced training of CFM.

In sum, both novice and experienced medics are for the most part able to execute all three lifesaving procedures within clinically acceptable times. Novice medics did not, as a group, complete procedures within the established standard time for success as defined by the DCMT competency standards for establishment of a patent airway and for needle decompression of pneumothorax. Experienced medics, as a group, take less time to complete procedures and in the aggregate performed within the time standards established by the DCMT. For experienced medics undergoing refresher training, video supplementation and/or videos and hands-on practice did not appear to be associated with significantly faster completion times compared to the extant DCMT curriculum. Finally, careful analysis of demographic factors including combat experience, civilian occupation, age, gender and others failed to identify any single or combination of factors which correlated with performance outcomes for the three procedures studied.

**Performance Summary**  
**Time to Complete Procedures**  
**Total # of pre-defined steps completed**

**Phase I Cohort**

Novice 68WMedics during initial Medic training

**Phase II Cohort**

Experienced 68WMedics – During Advanced Leadership Skills (ALS) course

|   | AIRWAY  |                 | HEMORRHAGE  |                | DECOMPRESSION |                 |
|---|---|-----------------|-------------|----------------|---------------|-----------------|
| DCMT Standard   | NA  | <b>180 sec.</b> | NA          | <b>90 sec.</b> | NA            | <b>155 sec.</b> |
|   | Total Steps   | Total Time      | Total Steps | Total Time     | Total Steps   | Total Time      |
| <b>PHASE I</b>  |   |                 |             |                |               |                 |
| <b>Novice Combat Medics studied during the last two weeks of primary medic training</b> |   |                 |             |                |               |                 |
| Mean  | 13  | 203.74          | 8           | 66.16          | 15            | 172.61          |
| N   | 374   | 372             | 399         | 398            | 399           | 395             |
| Std. Deviation  | 3.66  | 74.37           | 2.41        | 26.66          | 2.97          | 60.01           |
| <b>PHASE II</b>   |   |                 |             |                |               |                 |
| <b>Experienced Combat Medics studied during a refresher training program</b>            |   |                 |             |                |               |                 |
| <b><u>Group 1</u></b>   | <b><i>Standard Curriculum</i></b>                     |                 |             |                |               |                 |
| Mean  | 13  | 174.11          | 10          | 61.70          | 15            | 145.34          |
| N   | 74  | 73              | 77          | 76             | 77            | 76              |
| Std. Deviation  | 4.21  | 71.45           | 2.35        | 22.12          | 3.15          | 49.70           |
| <b><u>Group 2</u></b>   | <b><i>Standard Curriculum +Video</i></b>              |                 |             |                |               |                 |
| Mean  | 15  | 194.20          | 10          | 65.06          | 15            | 150.17          |
| N   | 60  | 60              | 64          | 64             | 64            | 63              |
| Std. Deviation  | 2.57  | 64.39           | 1.77        | 18.70          | 2.86          | 41.86           |
| <b><u>Group 3</u></b>   | <b><i>Standard Curriculum +Video + simulation</i></b> |                 |             |                |               |                 |
| Mean  | 14  | 197.93          | 10          | 65.50          | 15            | 143.34          |
| N   | 58  | 58              | 64          | 64             | 64            | 64              |
| Std. Deviation  | 3.84  | 83.23           | 2.24        | 25.38          | 2.74          | 48.14           |

See Appendix F for details of statistical analysis

**PERFORMANCE OF NOVICE (STUDENT) MEDICS**

*General*

1. On the whole, performance meets stated military expectations for the three procedures tested (airway restoration, control of life-threatening hemorrhage and treatment of tension pneumothorax). Novice medics uniformly completed the appropriate procedure, within a clinically acceptable timeframe. Novice 68W CFM, trained through DCMT's 14- to 16-

week program are able to recognize and act in key trauma scenarios, take body substance isolation precautions and stabilize simulated patients for further medical care without causing further injury. A discussion of the performance standards follows in the sections below. In general, the timeframe in which medics completed procedures varied little from the established performance standard when the standard was not met. A formal analysis to establish and recommend new standards based on the mean performance parameters observed in this study has not been completed and is beyond the scope of this study. The data collected may, however, be used to inform revision of established performance standards.

2. Research team confidence in the above finding is supported by a large sample size (399); uniform testing procedures; mainstream standard statistical analysis; and extensive observation by subject matter experts.

### *Tension pneumothorax*

3. The fact that novice medics on average did not perform the tension pneumothorax procedure in the target total time of 155 seconds merits further investigation and may merit reconsideration of the benchmark. The clinical significance of this finding is that the risk of respiratory insufficiency and cardiovascular collapse increase as seconds pass before decompression of the air-filled pleural space. The most important single parameter for this procedure is time to recognize pneumothorax and insert a decompression needle into the thorax at a 90-degree angle. Additional time is required to complete the procedure by securing the needle and re-assessing the patient. Novices required an average of 99 seconds to insert the needle, compared to groups of experienced medics who averaged between 85 and 101 seconds. All of the observed needle insertion times, in all groups, were within a clinically acceptable range. Differences in time to insertion between groups were clinically irrelevant. Because needle insertion requires fine motor skills, precision and confidence, performance on this element of the procedure may be enhanced by additional emphasis during training. One approach may be to add additional practice sessions on needle insertion, using simulators or partial task trainers.

### *Hemorrhage*

4. Application of a combat tourniquet for hemorrhage control of an exsanguinating limb injury was the most straightforward of the three procedures, and we observed the best performance relative to military benchmarks in the area of hemorrhage control. Training standards were met across the board. To make training better correspond to field experience, the research team suggests that future challenges with hemorrhage scenarios be incorporated in the form of adding at least one additional and perhaps multiple simulated hemorrhage victims to the scenario and for standards be established for correct placement of multiple tourniquets on multiple casualties.

### *Airway*

5. Novices (as well as experienced medics) failed to complete airway procedures within the 180-second standard. Average total airway procedure completion time was 203.7 seconds for novices, more than 20 seconds over the benchmark. This finding merits reconsideration of the benchmark. The clinical significance of failure to rapidly restore airway function is that for completely obstructed airways, death from hypoxia can ensue as early as three to five minutes after injury. Airway device placement time for novices using the Combitube was, on average, 107.12 seconds and 100.05 seconds for the King LT device. Assuming a 180-second target completion time for the airway procedure, 80 seconds or less remains for completion of the airway procedure (testing and inflating of cuffs, confirming tube placement, etc). While airway rescue device technology continually evolves it is clear that the primary 68W curriculum trains medics to recognize airway problems and implement procedures to restore airway patency. Integration of airway devices at DCMT, which are being utilized in deployed field units, is advised. For example, the Laryngeal Tube is used widely in deployment settings but is not uniformly taught as a primary rescue device in all settings. The Combitube is likewise not frequently used in combat care but continues to be integrated in DCMT training. Standardization of airway device selection for training should correspond to actual combat medic practice, as well as doctrine to the greatest extent possible, understanding that practice variation can be great.

6. In regard to the airway procedure, one facilitator had these observations on novice performance:

“Most of the new medics were very unfamiliar with the equipment and were more apt to go straight to cricothyroidotomy if a patient was not breathing. Several of the students were stumped when it came to airway management.”

Some factors merit further investigation to determine how airway training might be improved. Considerations include: 1) The lack of standard deployed equipment (King LT, Combitube, laryngeal mask airways etc), 2) Differing prior experiences with airway devices. The Combitube seemed favored by those with civilian experience at a time before the King LT was introduced and 3) Current doctrinal emphasis on inserting nasopharyngeal or oral airways alone to stabilize casualties for further airway interventions at higher echelons of care or after transition to non-hostile tactical settings. Clarity about the best approach is lacking for many students.

## **PERFORMANCE OF EXPERIENCED MEDICS**

*General, as compared to novices*

1. In general, performance meets stated military expectations for the three procedures tested (airway restoration, control of life-threatening hemorrhage and treatment of tension pneumothorax). Experienced medics were able to recognize and act in key trauma scenarios, take body substance isolation precautions and stabilize simulated patients for further medical care without causing further injury. As expected, they executed required procedures on average more quickly than did novices. The faster performance times were



however not in the range of performance improvement that would be clinically relevant in most situations, including combat trauma resuscitation.

2. Research team confidence in the above finding is supported by a large sample size (399+205 =604); uniform testing procedures; standard statistical analysis; and subject matter expert observations.

### *Training interventions*

3. The research team used a rigorous study design and statistical analysis to establish findings related to several training interventions for experienced medics. The findings indicate that there were no clinically significant detectable differences in the performance of the three clinical procedures based on the presence or absence of enhanced training with either a simple video review, or video review and practice using a high fidelity mannequin. In addition as stated above, as a group the performance differences between novice and experienced medics were clinically negligible, notwithstanding some statistical differences.

### *Airway issues*

Meriting further investigation is the fact that experienced medics in the intervention groups (video supplementation only vs. videos plus hands-on practice) took, on average, 194.20 and 197.93 seconds to complete airway procedures, respectively. Although these two subgroups of 64 subjects each did not on average meet the 180-second standard set by the Army, their 70 peers in the control group of experienced medics completed airway procedures on average in 174.11 seconds, meeting the standard. Thus, experienced medics who received enhanced training with video review with or without hands-on simulation practice prior to scenario based evaluation, took longer to completely secure an airway, and they completed more predefined steps than medics who had no enhanced refresher training. This curious observation may reflect the effects of refresher training on medics who conducted the scenarios in a more methodical and comprehensive manner incorporating extra steps to assure success; a Hawthorne effect<sup>1</sup>, whereby subjects improve or modify an aspect of their behavior being experimentally measured simply in response to the fact that they are being studied.

### *Limitations*

Factors which may have influenced and limit the interpretation of these findings include that sample size, because the number of experienced medic subjects was smaller than the novice sample (205 vs. 399). Educational intervention stratification further reduced the size of experienced medic subgroups for comparison analysis. An unbalanced cohort comparison was necessitated by this study design, with experienced medics comprising

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<sup>1</sup> See McCarney *et al*; Mayo; and Roethlisberger and Dickson in attached references.

three groups; 77 (control), 64 (control plus video) and 64 (control plus video plus hands-on simulation instruction).

As was noted in an interim report, it was more difficult to secure the participation of experienced medics in Phase II of the project, as the training window providing access to the Advanced Leaders Course was only two weeks long. In addition, to improve participation rates, experienced medics were allowed to visit the testing station at any point in their two-week session, whereas novice medics visited at the end of their intense and longer training period. This means that some experienced medics may not have had much or any refresher training before being tested, whereas most novices would have had repetitive and recent training. It is possible that this disparity may have contributed in some cases to ambiguous results that did not distinguish the performance of novice and experienced medics as clearly as might be expected. Another implication of the null hypothesis confirmation (eg. That there were negligible substantive differences between novice and experienced medic performance) is that performance expectations for experienced medics are met without the need for specific refresher training. The data suggests that experienced medics retain core lifesaving skills, regardless of specific trauma experience, duty assignments, or any combination of demographic factors. This suggests there may be ways to conserve training resources by allowing experienced medics to rapidly confirm skills competency with simulator-based tests, forgoing additional training for a large number of experienced medics with demonstrated skill performance to an established standard.

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## **Appendices**

- A.** Equipment inventory
- B.** Curriculum Vitae, on-site research facilitators
- C.** Instructor materials for on-site research facilitators
- D.** Assessment checklists based on military performance benchmarks (contains description of the airway, hemorrhage and pneumothorax scenarios)
- E.** Product Line Review presented March 7, 2007 and February 23, 2010
- F.** Draft article for submission to *Annals of Emergency Medicine*

## Appendix A - List of Major Equipment

| Major Equipment Type  | Serial Number         |
|-----------------------|-----------------------|
| SimMan STD            | 211m40070003 (01370)  |
| SimMan STD            | 211m40070011 (01373)  |
| Peripheral Kit        | 210PK40070394 (01022) |
| Peripheral Kit        | 210PK40070395         |
| Advanced Video System | 210av40070268 (01375) |
| Advanced Video System | 210av40070269 (01372) |
| Compressor            | 01371                 |
| Compressor            | 01374                 |

## Appendix B

**Rina Lynn Callaway**  
3326 Whisper Manor  
Cibolo, TX 78108  
Mobile: 210-421-4747  
Evening Phone: 210-589-2558  
DSN: 473-2108  
Email: [rina.callaway@lackland.af.mil](mailto:rina.callaway@lackland.af.mil)

**Country of citizenship:** United States of America  
**Veterans' Preference:** 5-point preference based on active duty in the U.S. Armed Forces; Pending disability rating.  
**Contact Current Employer:** Yes

**AVAILABILITY**

**Job Type:** Permanent  
Temporary

**Work Schedule:** Full Time  
Part Time  
Shift Work  
Intermittent

**WORK EXPERIENCE**

**US Safety Services** **2/2006 - Present**  
**San Antonio TX US**

**Salary: 10.50 USD Per Hour**  
**Hours per week: 20**

**Supervisor**  
Supervises and trains 60+ employees as an Emergency Medical Technician - Basic (EMT-B)  
Provides first line emergency medical care to patrons of large events such as concerts, NBA basketball games, Conventions and many other events in San Antonio. (Contact Supervisor: Yes, Supervisor's Name: Cristina Heaney, Supervisor's Phone: 210-687-1604)

**US Air Force 737 TRG/IDMT** **2/2003 - Present**  
**Lackland AFB Texas US**

**Salary: 48.000 USD Per Year**  
**Hours per week: 40**

**Supervisor Independent Medical Duty Technician**

Currently certified as a National Registry of Emergency Medical Technician (NREMT); expiration is 31 Mar 2011

Basic Life Support (BLS) Instructor; expires Oct 2010

Maintains a Secret Security Clearance; Expires Aug 2017

Program Manager of training of the largest Independent Duty Medical Technicians training program within USAF Medical Corps

Responsible for oversight of 3600+ annual hours training for 13 IDMT's, ensured training maintained at 100%

Training experience with **SimMan®** training simulator and application of moulage along with scenario based testing of medical skills for certification

Implemented monthly EMT training program eliminating need for biannual refresher, saved 520 training hours

Experience in directing functions such as medical, surgical or related health care administrative activities.

Knowledge of nursing theory and technique, aseptic technique, and patient needs, team nursing

Transportation of the sick and injured, emergency care

Medical terminology; anatomy and physiology

military public health and sanitation;

Sterilization and care and use of surgical instruments, Use of portable autoclave for surgical sanitation of instruments

organization and function of medical service;

resource management and administration

Basic pharmacology of medication and the administration, dosage, route and contraindication

medical ethics; legal aspects

Participates in the planning, providing and evaluating patient care and operating and maintaining therapeutic equipment

personnel and unit management; disaster preparedness; quality improvement; and risk management.

Trained to respond and manage mass casualty situations along with aircraft accident investigation.

Immunizations technician; vaccination procedures; methods of proper administration of intra-dermal, subcutaneous and intramuscular injections; mechanisms of anaphylaxis and shock; pharmacology of various drug groups

Electronic fundamentals as they apply to the electrocardiograph machine and automatic external defibrillator.

7 classes away from a Bachelor's Degree in Health and Science with a concentration in sports medicine

Volunteered medical oversight for base/community 5k runs ensuring safe/successful event for 10k+ participants

Performs operating inspections of ambulances and other response vehicles documents findings

(Contact Supervisor: Yes, Supervisor's Name: Donald Coughlin, Supervisor's Phone: 210-872-9375)

## **EDUCATION**

American Military University  
Charlestown , WV US  
Bachelor's Degree - 12/2009  
86 Semester Hours  
Major: Health and Science  
Minor: Sports Medicine  
GPA: 3.5 out of 4.0  
Relevant Coursework, Licensures and Certifications:  
SC102 Anatomy and Physiology I  
SC122 A&P I with lab  
MC360 Advanced Anatomy and Physiology  
SS134 Introduction to Psychology  
GM390 Nutrition  
MC380 Training and Conditioning

## **JOB RELATED TRAINING**

30-Jul-1987 MEDICAL SERVICE SPEC AEROMEDICAL  
403ABY90230C  
MED1301 INTRO TO MEDICAL ASSTNG  
MED1302 MEDICAL ASSISTING  
MED1303 ANATOMY AND PHYSIOLOGY  
MED1304 TRANS/RESCUE OF PATIENTS  
30-Jul-1987 USAF HEARING CONSERVATIONIST 403AZY90150  
BEE2313 HEARING CONSERVATION  
14-Mar-1997 PUBLIC HEALTH CRAFTSMAN 403ACY4E071  
ENM2305 PUBLIC HEALTH MANAGEMENT  
AEROSPACE MED SUPERVISIOR COURSE 403AZY4F071  
9-Dec-1997 USAF HEARING CONSERVATION CERT 403AZY4F0X1  
BEE2313 HEARING CONSERVATION  
15-Feb-2001 MEDICAL SERVICE CRAFTSMAN-IDMT 293AZR4N071  
006

EMT2301 INTRO EMERG MED TECH  
EMT2302 MGT COMMON MED DISORDERS 5.00

**Technical Core**

EMT2303 EMERG PROC/EXAM  
EMT2304 PUBLIC HEALTH  
EMT2305 CLINICAL PRACTICUM  
EMT2306 EMERGENCY SERVICE MGT  
14-Feb-2002 AIR FORCE SPECIALTY INTERNSHIP 665INT00570  
000  
19-Apr-2002 PHOENIX READINESS IDMT COURSE 335AMC4NXXX  
000  
MRD1301 ADV MEDICAL READINESS 4.00  
1-Jul-2004 NCO ACADEMY (NCOA) 315NCO99200  
LMM2121 LEADERSHIP/MANAGEMENT II  
LMM2122 MANAGERIAL COMM II  
LMM2123 MILITARY STUDIES II  
SG474 ETHICS IN AMERICA  
SG532 PRINCIPLES OF SUPERVISION  
RQ295 - Foundations of Online Learning  
HS101 - American History to 1877  
MA112 - College Algebra  
SC102 - Introduction to Human Anatomy and Physiology  
SC122 - Introduction to Human Anatomy And Physiology Lab  
SS111 - Introduction to Geography  
SS134 - Introduction to Psychology  
GM390 - Nutrition  
MC360 - Advanced Human Anatomy and Physiology  
MC380 - Training and Conditioning

**TOTAL SEMESTER HOURS RECORDED**

Military 71.00 Civilian 28.00 Exam 6.00 All Sources 105.00

**REFERENCES**

|                        |                                 |                   |
|------------------------|---------------------------------|-------------------|
| <b>Ian Coon</b>        | USAF                            | MSgt              |
| <b>Phone Number:</b>   | (210)262-9422                   |                   |
| <b>Email Address:</b>  | ian.coon@lackland.af.mil        |                   |
| <b>Reference Type:</b> | Professional                    |                   |
| <b>Herbert Andrews</b> | USAF                            | TSgt              |
| <b>Phone Number:</b>   | 210-787-9174                    |                   |
| <b>Email Address:</b>  | herbert.andrews@lackland.af.mil |                   |
| <b>Reference Type:</b> | Professional                    |                   |
| <b>Cristina Heaney</b> | Safety Services                 | Owner of Business |
| <b>Phone Number:</b>   | 210-687-1604                    |                   |
| <b>Email Address:</b>  | cheaney@ussafetyservices.com    |                   |
| <b>Reference Type:</b> | Professional                    |                   |
| <b>Donald Coughlin</b> | USAF                            | MSgt              |
| <b>Phone Number:</b>   | 210-872-9375                    |                   |
| <b>Email Address:</b>  | Donald.Coughlin@lackland.af.mil |                   |
| <b>Reference Type:</b> | Professional                    |                   |



**Dario Guerra IV**  
515 Stable Vista  
San Antonio, TX. 78227  
Home: (210) 673-7486  
Cell: (210) 846-4385  
Email: dguerra11@satx.rr.com

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**OBJECTIVE:**

To obtain a position that I will be able to utilize the 20 years of previous medical work experience, while enhancing the growth of my future employer.

**QUALIFICATIONS:**

- Work well without supervision
- Ability to prioritize and remain focused on the essence of an issue
- Maintains Texas Paramedic, ACLS/BCLS instructor, PALS certifications
- Excellent computer skills; MS Office, Internet
- 20 years customer support service/experience
- Bilingual English/Spanish

**EXPERIENCE:**

**01/89-09/99    *United States Air Force***

***Medical Service Specialist***

- Managed emergency department personnel/equipment as shift leader
- Highly trained technician, sought by medical staff as an enlisted leader/local policy expert
- Trained, oriented, mentored and evaluated emergency department technician staff
- Performed technical, clerical, and patient attending duties efficiently
- Maintained cohesion during emergency department managers absence

**10/99-01/09    *United States Air Force***

***Independent Duty Medical Technician (IDMT)***

- Managed health/safety of 35,000 basic military trainees annually
- Directly supervised the duties/training of 10 IDMTs
- Streamlined processes to improve trainee access to care
- Conducted inspections of living/dining facilities to address potential communicable disease processes
- Managed clinic operations, including staff scheduling, ordering of supplies/equipment, and unit administration duties

**AWARDS:**

- 1993: 1st Medical Group, Langley AFB, VA.-Airman of the Quarter
- 1997: 7th Medical Group, Dyess AFB, TX.-NCO of the Year
- 1999: Paramedic of the Year-Abilene, TX
- 2001: Air Force Materiel Command-Sarah P. Wells Medical Technician of the Year
- 2003: Arnold AFB, TN.-NCO of the Year
- 2005: 737th Training Group, Lackland AFB, TX.-IDMT of the Year

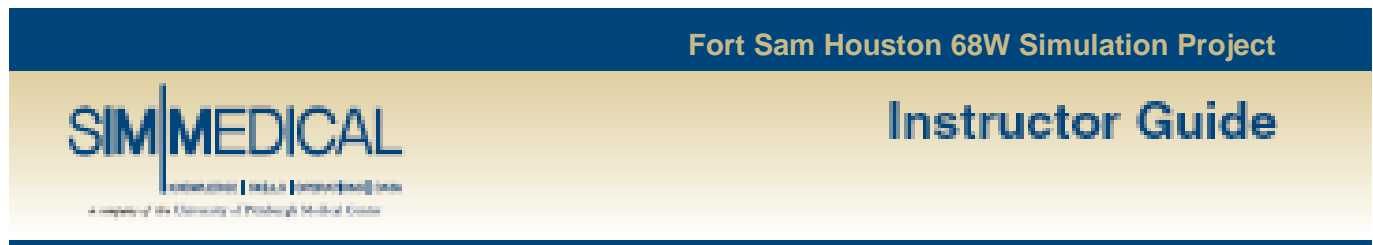
**EDUCATION:**

- 1988- High School Diploma/San Isidro High School, TX.
- Attended Airman Leadership school and NCO Academy
- Some college coursework

**REFERENCES:**

Available on request.





## PROGRAM OVERVIEW



## Instructor Guide

### Program Description

The purpose of this research study titled “Ft. Sam 68 Whiskey Combat Medic Medical Simulation Training Quantitative Integration Enhancement Program” is to determine performance characteristics of combat field medics when caring for simulated victims of combat casualties. You are being asked to participate in a research study in which we will assess performance on three separate scenarios. These topics are hemorrhage control, airway management, and tension pneumothorax. These scenarios are designed to evaluate the performance of medics while they provide combat field care.

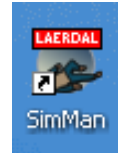
### Participant Information

Participants in this program will be required to:

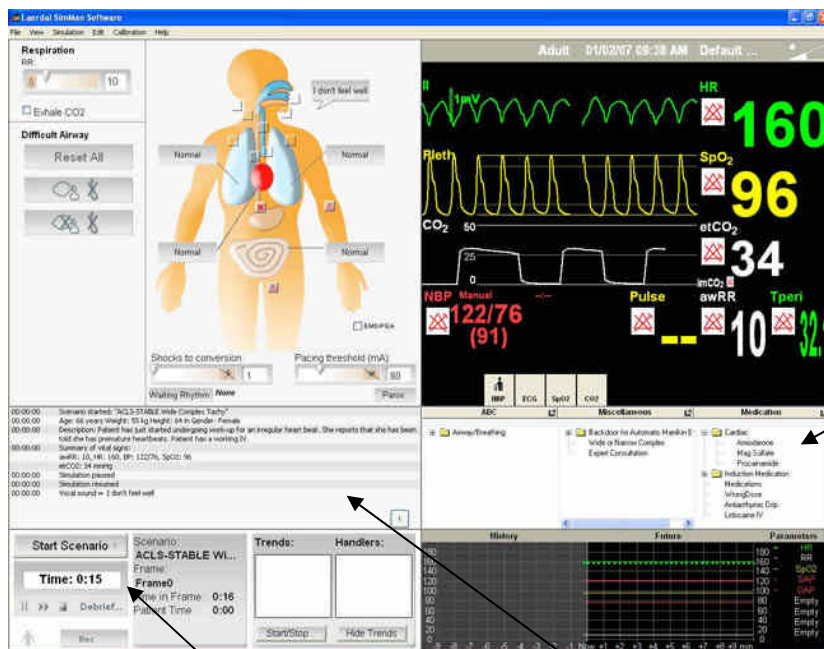
1. Wear Army Combat Uniform (ACU)
2. Wear a ballistic helmet (if available)
3. Wear individual body armor with ballistic armor plates (if available)
4. Wear Improved First Aid Kit (IFAK) (if available)
5. Utilize medical supplies provided at each station

## Start-Up Instructions for SimMan

- 1 - Boot up computer
- 2 - Once you are at the Desk Top, open SimMan software by clicking on SimMan icon
- 3 - When the SimMan/SimBaby software opens to the log in box, turn on the Link Box
- 4 - Continue with log in instructions on SimMan software. Once connected to Link Box, the red light on the Link Box should be solid.



## SimMan Graphic User Interface (GUI)



Vital signs controls – Click on a number or waveform to open and change properties for that parameter

Scenario events control – All scenario events that require instructor are located here. To activate, just click on the event. Note that some folders have a “+” sign next to them indicating there are additional events in that folder. Click on the plus sign to open the folder and gain access to those events.

Scenario controls – From this area, the instructor can select the scenario to be used; start, stop or pause the scenario; and go to the debriefing screen.

Event log – All events and changes in simulator functions can be monitored here. This is a good area to use when the instructor wants to review what the student has done while the case is still active.

Trends Preview – Displays a graphic of what monitoring parameters will be over time given the current participant actions.

## Scenarios to be Evaluated

There are three scenarios in which participants will be evaluated in this project.

1. Airway management with application of either a Combitube or an LMA.
2. Hemorrhage control with application of a Combat Application Tourniquet
3. Needle reduction of a tension pneumothorax.

Each scenario has its own scenario file with embedded evaluation checklist.

**General Instruction to Participants (Phase I)**

*These instructions are to be read to participants prior to their signing consent form before starting simulations in Phase I of the research study.*

“The purpose of this research study titled “Ft. Sam 68 Whiskey Combat Medic Medical Simulation Training Quantitative Integration Enhancement Program” is to determine performance characteristics of combat field medics when caring for simulated victims of combat casualties. You are being asked to participate in a research study in which we will assess performance on three separate scenarios. These scenarios are designed to evaluate the performance of medics while they provide combat field care. These topics are hemorrhage control, airway management, and tension pneumothorax. The assessment scenarios will be conducted at one assessment station and data collection will be performance-based. The assessment stations will be staffed with personnel qualified to both instruct the simulation and collect data. At the conclusion of the third scenario, you will be given a debriefing of the three scenarios and allowed an opportunity to ask questions about your performance. As well, the training process across the three scenarios described above will be videotaped for the purposes of ensuring quality and reliability of the training process. We will also collect brief (approximately 10 minutes) survey data from each person regarding their previous medical experience, as well as basic demographic information.

“As the performances will be videotaped, you will have the ability to opt out of the project entirely or to continue to participate in the project while opting out of the video recording. All information provided on surveys and checklists for performance will be kept confidential through assigning each participant a unique ID number. Research personnel will be the only people to handle information. Risk is deemed to be minimal and is no different or less than the risks associated with other types of training or clinical environments. You will not receive any compensation (payment) for participation in this study. Your participation is voluntary, and you can withdraw from the study at any time. The Principal Investigator, MAJ Robert L. Mabry, MD or a member of USAMRMC Liaison Office-Fort Sam Houston staff, who can be reached at (210) 221-3858, will be available to answer any questions concerning procedures throughout this study.”

## General Instruction to Participants (Phase II)

*These instructions are to be read to participants before prior to their signing consent form starting simulations in Phase II of the research study.*

“The purpose of this research study titled “Ft. Sam 68 Whiskey Combat Medic Medical Simulation Training Quantitative Integration Enhancement Program” is to determine performance characteristics and to assess the effect of three training formats of combat field medics when caring for simulated victims of combat casualties. You are being asked to participate in a research study in which we will assess performance on three separate scenarios. These scenarios are designed to evaluate the performance of medics while they provide combat field care. These topics are hemorrhage control, airway management, and tension pneumothorax. You will be randomly assigned to one of two training modalities or to a control group and will be assessed on performance across all three scenarios. These groups are as follows:

1. The control group consists of the standard training provided in the DCMT curriculum.
2. The first training modality group will be a hands-on training group, in which the participants will be asked to respond appropriately to standardized scenarios on a simulator and receive instructor feedback concerning their performance.
3. The second training modality involves the participants watching a standardized annotated re-enactment of the 3 scenarios being executed correctly. Following the video the participants will be asked to perform the necessary skills on the simulator.

“The simulation stations will be staffed with personnel qualified to both instruct the simulation and collect data. At the conclusion of the third scenario, you will be given a debriefing of the three scenarios and allowed an opportunity to ask questions about your performance. As well, the training process across the three scenarios described above will be videotaped for the purposes of ensuring quality and reliability of the training process. We will also collect brief (approximately 10 minutes) survey data from each person regarding their previous medical experience, as well as basic demographic information.

“As the performances will be videotaped, you will have the ability to opt out of the project entirely or to continue to participate in the project while opting out of the video recording. All information provided on surveys and checklists for performance will be kept confidential through assigning each participant a unique ID number. Research personnel will be the only people to handle information. Risk is deemed to be minimal and is no different or less than the risks associated with other types of training or clinical environments. You will not receive any compensation (payment) for participation in this study. Your participation is voluntary, and you can withdraw from the study at any time. The Principal Investigator, MAJ Robert L. Mabry, MD or a member of USAMRMC Liaison Office-Fort Sam Houston staff, who can be reached at (210) 221-3858, will be available to answer any questions concerning procedures throughout this study.

## Airway

### Scenario Overview

The Airway scenario presents a casualty who is respiratory arrest and requires advanced airway placement. The participant will need to place either a Combitube or a King LT Airway. If an advanced airway is not placed quickly, the casualty's condition will begin to rapidly deteriorate 3 minutes into scenario.

In the tactical field care phase of treatment, the soldier confronts an unconscious casualty who is not breathing and will require the insertion of an esophageal King LT or a Combitube. There is an assistant available to aid in performing resuscitative measures. No cervical spine injury is present. Necessary materials and equipment: King LT and a Combitube, syringes provided in kit based on size, gloves, stethoscope, and bag-valve-mask (BVM).

Standards: Inserted the Combitube or King LT within 1 minute and successfully ventilated the casualty without causing further injury.

### Scenario Specific Instructions to Participant

You are in the Tactical Field Care treatment phase and have been called to aid a casualty who has been found unresponsive. Immediate enemy threat has been neutralized. You have an assistant to perform basic procedures under your direction.

## Airway

### Equipment

#### Equipment

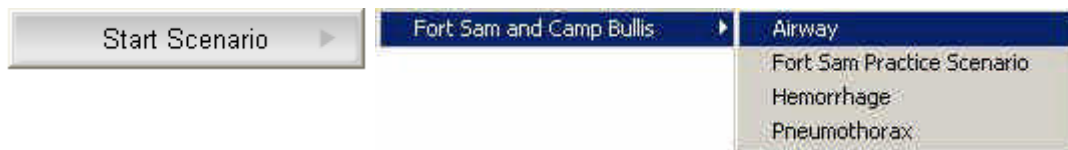
|   |
|---|
| King LT #4 King LT Airway (#4) with appropriate syringe (1 per station) |
| Combitube (#41) with appropriate syringes (1 per station)               |
| Scissors (1 per station)  |
| Exam gloves (enough for all participants)                               |
| Eye protection (1 per station)  |
| 2" Tape   |
| Bag/Mask Device (1 per station)   |
| Stethoscope (1 per station)   |

### Simulator Preparation

- SimMan simulator will be dressed in Army Combat Uniform
- Simulator will be supine on floor or ground

### Starting the Scenario

Scenario file Combat Medic/Airway should be loaded by clicking on the Start Scenario button in the Graphic User Interface.



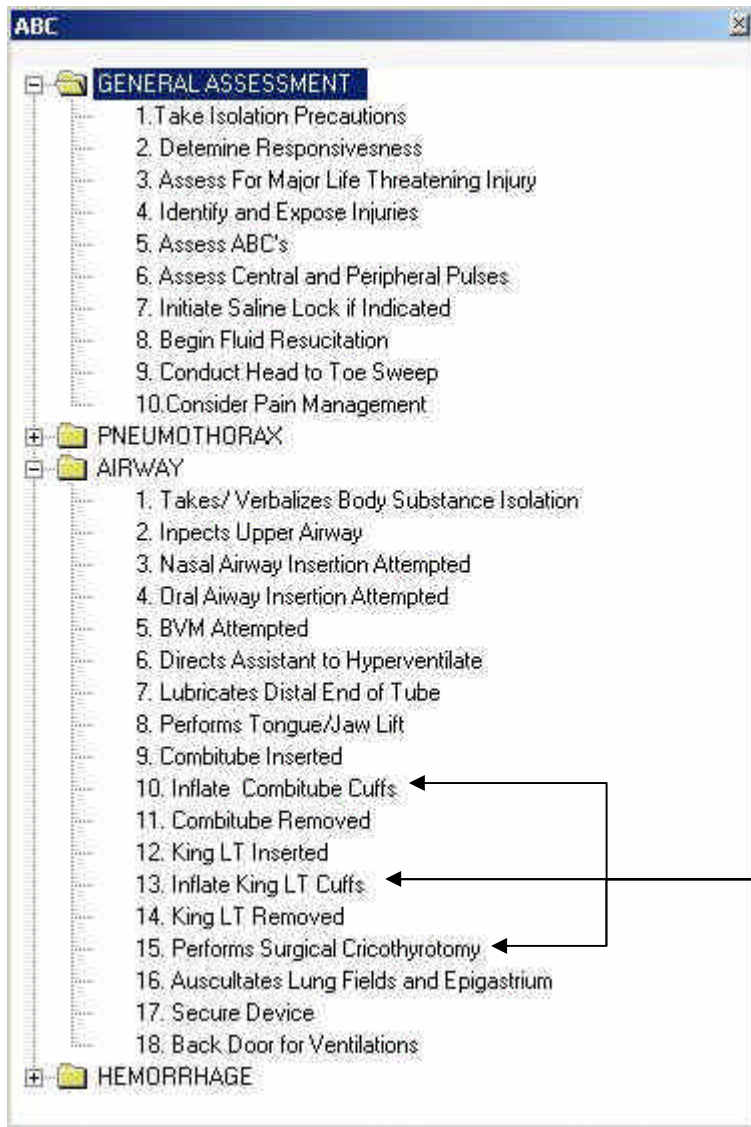
When prompted by the SimMan interface to select video recording, respond by selecting Yes. The scenario will start running immediately after selecting Yes.






## Airway

## Event Menu



Note – Undock ABC menu from original menu location by clicking on the  symbol in the upper right hand corner of the menu box. Open folders needed for this scenario. Expand Menu window as needed. All items need for this scenario are found under General Assessment and Airway folders.

The Event Menu serves as the evaluation checklist for this project.

Critical Event that will direct scenario to successful conclusion

## Airway

### Instructor Actions

After introducing scenario to the participant, activate the scenario using the Start Scenario button. The scenario will begin playing immediately.

As the participant completes each action, the Instructor should click on the appropriate event in the Event Menu.

The scenario is terminated when:

- the participant secures the airway with tape,
- or If, after 10 minutes, the participant has failed to place an advanced airway

Once the scenario has been terminated, the Event Log should be saved by going to the debriefing screen. This is done by clicking on the Debriefing button on the lower left of the GUI.



Once the debriefing screen is open, click on File in the upper left corner and select Save As. Save the file in the appropriate location with the assigned file name protocol.

Naming protocol:

FS001A (Example)

FS = Fort Sam  
 CB = Camp Bullis  
 001 = Subject Number  
 A = Airway scenario  
 H = Hemorrhage scenario  
 T = Tension pneumothorax scenario



Close the debriefing viewer and return the SimMan GUI.

## Hemorrhage

### Scenario Overview

The Hemorrhage scenario presents a casualty with life threatening bleeding from a traumatic amputation of the left leg at the distal femur. The participant will need to place a Combat Application Tourniquet. If the CAT is not applied quickly, the casualty's condition will begin to rapidly deteriorate 90 seconds into the scenario.

The soldier will be in a tactical environment under direct enemy fire and encounter a casualty with life-threatening bleeding from an extremity. The soldier will have a tactical medical backpack, an M4 carbine, ballistic helmet, and individual body armor with ballistic armor plates, and a fully stocked improved first aid kit (IFAK).

Standards: Stop life threatening hemorrhage with a combat application tourniquet or improvised tourniquet within 60 seconds of encountering the patient.

### Scenario Specific Instructions to Participant

You are in a Care Under Fire situation and have been called to assist a casualty injured by an improvised explosive device (IED). The area is not secure and active enemy fire is continuing.

## Hemorrhage

### Equipment

#### Equipment

|   |
|---|
| Improved First Aid Kit (IFAK) – Fully stocked including Combat Application Tourniquet (1 per station) |
| Scissors (1 per station)  |
| Exam gloves (enough for each participant)   |
| Eye protection (1 per station)  |
| 2" Tape   |

### Simulator Preparation

- SimMan simulator will be dressed in Army Combat Uniform
- Simulator will be supine on floor or ground
- Left leg on simulator will be replaced with Traumatic Amputation Leg from the Bleeding Trauma Module (Laerdal Product Number 381550)
- Left pant leg of ACU will be cut off at mid-thigh
- Simulated blood solution will be placed on ground below injury site

### Starting the Scenario

Scenario file Combat Medic/Hemorrhage should be loaded by clicking on the Start Scenario button in the Graphic User Interface.

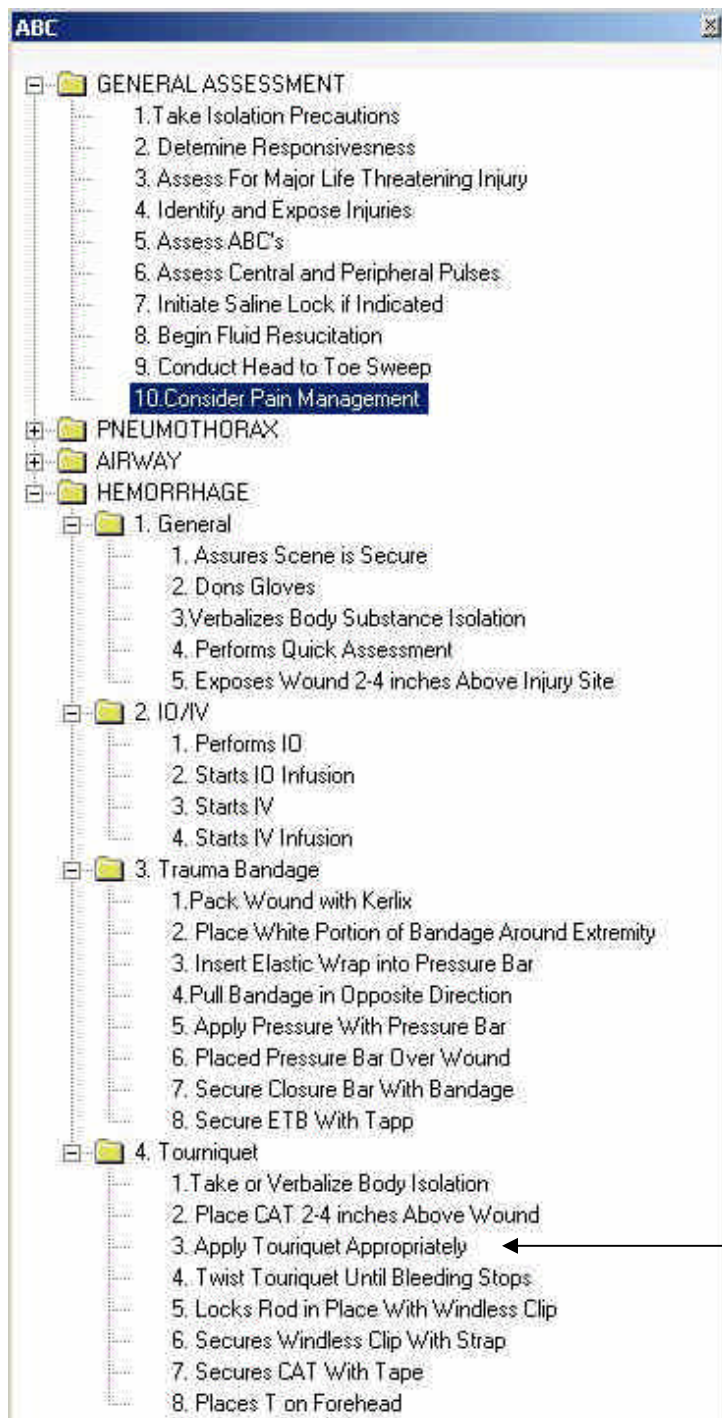



When prompted by the SimMan interface to select video recording, respond by selecting Yes. The scenario will start running immediately after selecting Yes.



## Hemorrhage

### Event Menu



Note – Undock ABC menu from original menu location by clicking on the  symbol in the upper right hand corner of the menu box. Open folders needed for this scenario. Expand Menu window as needed. All items need for this scenario are found under General Assessment and Hemorrhage folders.

The Event Menu serves as the evaluation checklist for this project.

Critical Event that will direct scenario to successful conclusion

## Hemorrhage

### Instructor Actions

After introducing scenario to the participant, activate the scenario using the Start Scenario button. The scenario will begin playing immediately.

As the participant completes each action, the Instructor should click on the appropriate event in the Event Menu.

The scenario is terminated when:

- the participant secures the CAT with tape,
- or If, after 10 minutes, the participant has failed to place the CAT

Once the scenario has been terminated, the Event Log should be saved by going to the debriefing screen. This is done by clicking on the Debriefing button on the lower left of the GUI.



Once the debriefing screen is open, click on File in the upper left corner and select Save As. Save the file in the appropriate location with the assigned file name protocol.

Naming protocol:

FS001A (Example)

FS = Fort Sam  
 CB = Camp Bullis  
 001 = Subject Number  
 A = Airway scenario  
 H = Hemorrhage scenario  
 T = Tension pneumothorax scenario



Close the debriefing viewer and return the SimMan GUI.

## **Pneumothorax**

### **Scenario Overview**

The Pneumothorax scenario presents a casualty with a penetrating injury to the chest and worsening respiratory distress. The participant will need to perform a needle chest decompression. If a needle decompression is not accomplished within 2.5 minutes the casualty's condition will begin to rapidly deteriorate.

In the tactical field care phase of treatment, the soldier is called to provide aid to a conscious, breathing chest casualty with penetrating chest trauma and progressive respiratory distress who requires needle decompression. Necessary materials and equipment: stethoscope, large bore needle (10 to 14 gauge, 3-1/4 inch long) alcohol swab, and exam gloves.

Standards: Completed all the steps necessary to perform a needle chest decompression in order, without causing unnecessary injury to the casualty.

### **Scenario Specific Instructions to Participant**

During the Tactical Field Care treatment phase, you have been called to aid a casualty that has been shot. The casualty appears conscious but distressed. Enemy fire has been neutralized and there is no immediate enemy threat.



## Pneumothorax

### Equipment

#### Equipment

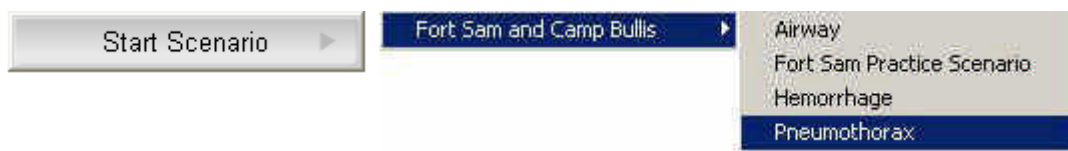
|  |
|--|
| 3.25 inch 14 gauge catheter (1 for each participant) |
| Antiseptic Swabs (1 for each participant)            |
| Scissors (1 per station)                             |
| Exam gloves (enough for each participant)            |
| Eye protection (1 per station)                       |
| 2" Tape  |
| Stethoscope (1 per station)                          |

### Simulator Preparation

- SimMan simulator will be dressed in Army Combat Uniform
- Simulator will be supine on floor or ground
- GSW through clothing on simulator's left anterior chest, mid- clavicular line, approximately 6<sup>th</sup> intercostal space
- GSW wound on left chest (Simulate with masking tape with black marker circle for wound)

### Starting the Scenario

Scenario file Combat Medic/Pneumothorax should be loaded by clicking on the Start Scenario button in the Graphic User Interface.



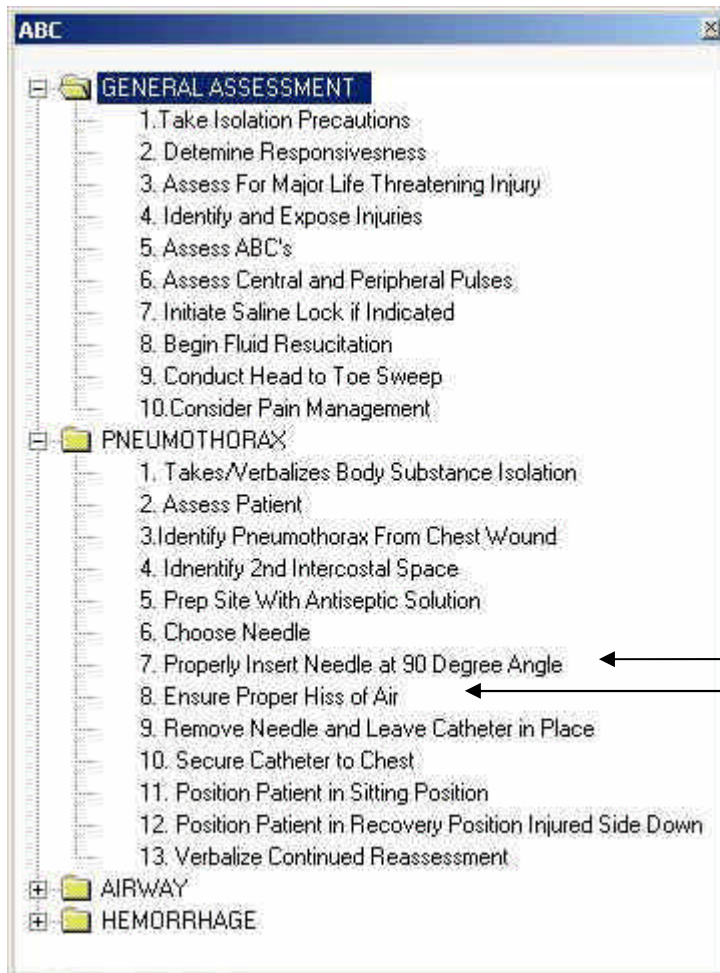
When prompted by the SimMan interface to select video recording, respond by selecting Yes. The scenario will start running immediately after selecting Yes.






## Pneumothorax

### Event Menu



Note – Undock ABC menu from original menu location by clicking on the  symbol in the upper right hand corner of the menu box. Open folders needed for this scenario. Expand Menu window as needed. All items need for this scenario are found under General Assessment and Pneumothorax folders.

The Event Menu serves as the evaluation checklist for this project.

Critical Event that will direct scenario to successful conclusion

After successful placement of the catheter, the evaluator should inform participant "At this time you hear a hiss of air coming from the needle catheter."

## Pneumothorax

### Instructor Actions

After introducing scenario to the participant, activate the scenario using the Start Scenario button. The scenario will begin playing immediately.

As the participant completes each action, the Instructor should click on the appropriate event in the Event Menu.

The scenario is terminated when:

- the participant successfully decompresses the chest,
- or If, after 10 minutes, the participant has failed to decompress the chest

Once the scenario has been terminated, the Event Log should be saved by going to the debriefing screen. This is done by clicking on the Debriefing button on the lower left of the GUI.



Once the debriefing screen is open, click on File in the upper left corner and select Save As. Save the file in the appropriate location with the assigned file name protocol.

Naming protocol:

FS001A (Example)

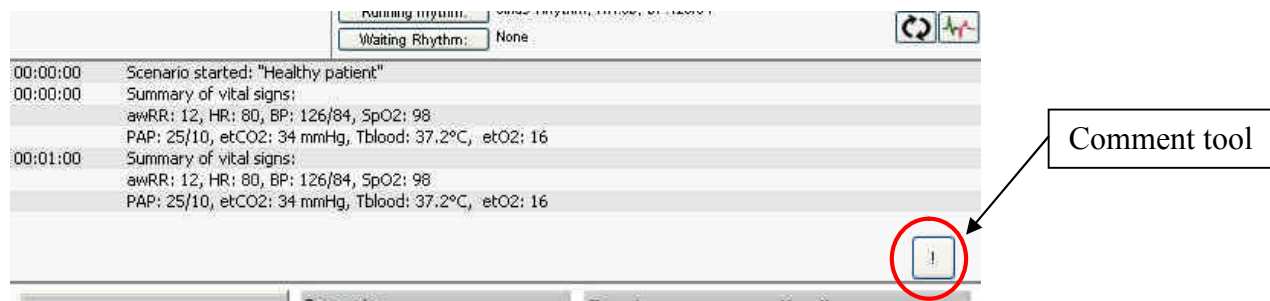
FS = Fort Sam  
 CB = Camp Bullis  
 001 = Subject Number  
 A = Airway scenario  
 H = Hemorrhage scenario  
 T = Tension pneumothorax scenario



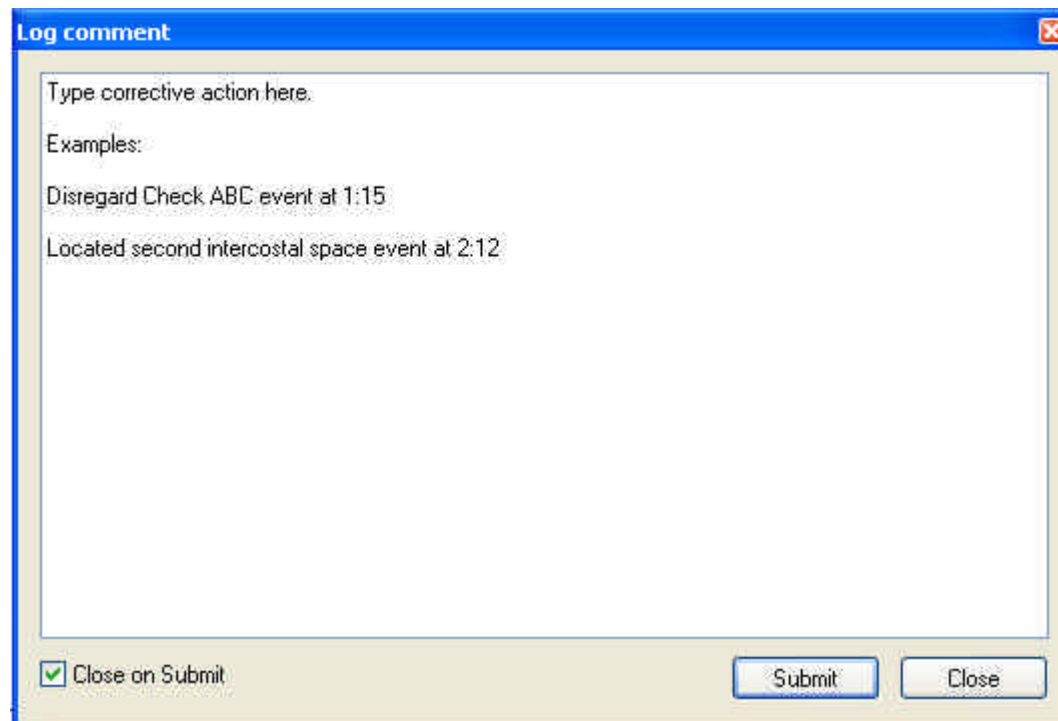
Close the debriefing viewer and return the SimMan GUI.

## Error Correction

In the event of inadvertent or missed event selections (mouse clicks on the event menu), open the Comment Tool on the SimMan GUI.



Type the corrective actions into the comment box and then click on Submit.





## Instructor Guide

### APPENDIX

## GLOSSARY OF TERMS

1. **Debriefing.** A post-simulation session designed to promote reflective learning typically conducted immediately after the simulation session and focused on specific participant performance or behavior elements.
2. **Fidelity:** The degree to which a device (simulator) or condition (scenario) accurately reproduces the reality of the corresponding clinical situation.
3. **Full-Task Training.** An approach to simulation education in which the environment, simulator, or curriculum is used to represent an entire clinical situation, process, or interaction.
4. **Healthcare Simulation:** Curriculum designed to mimic the reality of a clinical environment, realistically demonstrate procedures, and stimulate decision-making or critical thinking for healthcare education using role play, manikins, representative objects, and/or interactive videos.
5. **Instructor:** The teacher or trainer during the simulation session; participates by observing and documenting actions of the participants and providing feedback during the debriefing session.
6. **Learning Objective:** Measurable expectations of behavioral attributes to be accomplished by the participant. These objectives can be measured through formative assessments, summative assessments, and authentic experience.
7. **Overall Course Objective/Description Summary:** Statement describing the principle objective and rationale of the course.
8. **Part or Partial-Task Training:** An approach to simulation education in which the environment, simulator, or curriculum is used to represent a specific or limited task, process, or interaction.
9. **Participant:** The person who has been identified as a member of the target audience for the simulation experience; the learner.
10. **Ring of Knowledge (ROK) Cards:** Used in the clinical environment as quick, pocket reference guides for healthcare providers. The portability of ROK cards arm providers with easy access to key practices and policies in an effort to promote safe patient care delivery.
11. **Simulation Class:** A given instance of the delivery of a simulation course. It may be grouped into one or multiple days.
12. **Simulation Scenario:** A session with a specific learning objective(s) where the participant takes part in some form of simulated event and is expected to perform certain tasks. These tasks may include interactions with a computerized human simulator, a part-task trainer, or a simulated patient.
13. **Simulation Session:** Any activity that can occur during a given block of time, during a given day, of a given class. Examples include a dynamic scenario, a skill station, a didactic lesson, or an assessment session.
14. **Simulator:** A device or machine that simulates an environment for training purposes.

## 10 STEPS TO SUCCESSFUL SIMULATION

### 1. Instructor preparation

- ☐ Review the curriculum package with focus on course and scenario objectives.
- ☐ Review the Instructor Guide and didactic material to ensure familiarization.
- ☐ Review the Scenario and Debriefing Guide prior to running the scenarios.
- ☐ Prepare equipment and materials (simulator, technology, audio-visual (AV), etc)
- ☐ Conduct practice session with other instructors and/or subject matter experts.

### 2. Technical equipment preparation (simulators, AV equipment, software, hardware)

- ☐ Identify simulators and verify function.
- ☐ Test all systems if using AV.
- ☐ Practice using software/simulator.
- ☐ Ensure hardware devices are functioning properly.

### 3. Non-technical equipment preparation (props, supplies, charts, stethoscopes, etc)

- ☐ Refer to equipment checklist for accurate stock totals.
- ☐ Gather needed props and supplies and verify that they are in working order.

### 4. Environmental preparation<sup>4</sup>.

- ☐ Set up the simulation area for the scenario.
- ☐ Verify function of equipment or devices within the environment.

### 5. Simulation environment introduction

- ☐ Verify that instructors and participants are familiarized with important aspects of the simulation environment (simulation room/simulator).
- ☐ Conduct “meet the simulator” exercise if applicable.

## 10 STEPS TO SUCCESSFUL SIMULATION

### 6. Instructor behavioral expectations (The Five P's)

- ☐ Preparation: evaluate participant completion of pre-class material (if applicable).
- ☐ Professionalism: maintain a professional demeanor, act as you would in a normal clinical environment.
- ☐ Patient safety: focus on *what* is right and not *who* is right.
- ☐ Participate: maximize learning by encouraging active participation.
- ☐ Performance: during debriefing sessions, focus should be on the performance not the performer.

### 7. Scenario start and stop points

- ☐ Clearly define the initiation and termination points of the scenario.
- ☐ Adhere to these points and avoid unreasonable extension.

### 8. Errors and glitches

- ☐ Anticipate that small periods of downtime may occur.
- ☐ Have Participant Guide available for supplemental learning.
- ☐ Avoid blaming the simulator, participants, or props for unexpected downtime.

### 9. Debriefing

- ☐ Facilitate active debriefing with identification of areas for improvement.
- ☐ Provide respectful, professional, and prompt feedback.
- ☐ Consider participant experience in gauging level of debriefing detail.
- ☐ Include examples of best practices, supporting evidence, and current literature in debriefing points.
- ☐ Refrain from instructor or group ridicule.

### 10. Improving performance

- ☐ Utilize checklists or other assessment tools to provide feedback.
- ☐ Apply assessment findings to promote improvement of future sessions.
- ☐ Review participant course and instructor evaluations for quality improvement.

## TECHNICAL CONSIDERATIONS

### **Video Debriefing System**

*Recommended:*

Laerdal Advanced Video System (AVS-US)

*Minimum requirement:*

System which permits audio to be recorded with the video portion of the scenario, allowing accurate debriefing of the simulation session.

### **Computer**

Recommended System Requirements:

Operating System: Windows XP

CPU: Pentium M 1.8Ghz or Pentium 4 2.7 GHz or similar (Athlon 64 1.8GHz or Athlon XP 2GHz)

RAM: 512MB

HDD: 400MB free space

CD Drive

### **Video Display**

Projector or large screen monitor

### **Software**

Adobe Acrobat Reader 7 or higher

Adobe Flash Player 9 or higher

It is recommended to have a simulator that can be ventilated and detect shocks. It is also recommended (but not required) to have a patient monitor in the simulation room.





## OCCLUSIVE DRESSING



**Conditions:** In the tactical field care phase of treatment, a patient presents with an open chest wound with or without respiratory compromise. Necessary materials and equipment: scissors, adhesive tape, field dressings, exam gloves, occlusive material or Asherman Chest Seal (ACS.)

**Standards:** Treated any open chest wound, minimizing the effects of the injury. Sealed the entry and exit wounds.

| ACTIONS:   | 1 / 0 |
|--|-------|
| 1. Takes or verbalizes body substance isolation.   |       |
| 2. Exposes injury.   |       |
| 3. Upon full expiration, covers the wound with large, occlusive material dressing, covering the first wound encountered.   |       |
| 4. Tapes four sides of occlusive dressing down. (Occlusive material should extend 2" beyond the edge of the wound.)        |       |
| <b>Evaluator: "How do you secure the dressing if you do not have the ability to perform a needle chest decompression?"</b> |       |
| 5. Log rolls the patient or has the conscious patient sit up and examines the back for an exit wound.                      |       |
| 6. Covers the exit wound on expiration, if present with large, occlusive dressing.   |       |
| 7. Tapes four sides occlusive dressing down. (Occlusive material should extend 2" beyond the edge of the wound.)           |       |
| 8. Places patient in sitting position or injured side down in the recovery position.                                       |       |
| 9. Verbalizes continued assessment of casualty for signs of progressive respiratory distress.                              |       |
| TOTAL:   |       |
| TOTAL POSSIBLE:  | 9     |

### CRITICAL CRITERIA

Failed to take body substance isolation precautions.  
 Failed to use occlusive dressing to seal the wounds.  
 Failed to check or dress the exit wound.  
 Occlusive dressing does not adhere to the chest wall.  
 Failed to reassess the patient for progressive respiratory distress.  
 Caused further injury to the patient

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## COMBITUBE



**Conditions:** In the tactical field care phase of treatment, an unconscious, casualty requiring ventilatory assistance, requires the insertion of an esophageal combitube. No cervical spine injury is present. Necessary materials and equipment: Combitube, syringe provided in kit, gloves, stethoscope, and bag-valve-mask (BVM).

**Standards:** Successfully placed the combitube and provided adequate ventilation to the casualty without causing further injury to the casualty in less than 1 minute.

| ACTIONS:  | 1 / 0    |
|---|----------|
| 1. Takes or verbalizes body substance isolation.  |          |
| 2. Inspects upper airway for visible obstruction.   |          |
| 3. Directs assistant to hyperventilate the patient for a minimum of 30 seconds.   |          |
| 4. Inspects and tests equipment.  |          |
| 5. Verbalizes lubricating distal end of tube.   |          |
| 6. Performs a tongue-jaw lift.  |          |
| 7. Inserts device so casualty's teeth sit between printed black rings.  |          |
| 8. Inflates #1 (blue) balloon with 100 mL of air and removes syringe.   |          |
| 9. Inflates #2 (white) balloon with 15 mL of air and removes syringe.   |          |
| 10. Directs assistant to ventilate casualty with a BVM through primary (blue) tube.   |          |
| 11. Auscultates lung fields and epigastrium to confirm tube placement.  |          |
| <b>Evaluator: "You do not see rise and fall of the chest and you only hear sounds over the epigastrium."</b>                                | <b>X</b> |
| 12. Direct assistant to ventilate casualty with BVM through the secondary (white) tube.   |          |
| 13. Informs evaluator how tube placement would be confirmed.  |          |
| <b>Evaluator: "You see rise and fall of the chest, hear breath sounds in all four lung fields and hear no sounds over the epigastrium."</b> | <b>X</b> |
| 14. Secures device to the casualty.   |          |
| TOTAL:  |          |
| TOTAL POSSIBLE:   | 14       |

### CRITICAL CRITERIA

Failed to take body substance isolation precautions.

Failed to insert the Combitube at the proper depth or place within 3 attempts.

Fail to test or properly inflate the cuffs once device was inserted.

Failed to confirm tube placement.

Caused further injury to the patient

Failed to perform steps 2 through 10 in less than 1 minute

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# KING-LT AIRWAY



**Conditions:** In the tactical field care phase of treatment, an unconscious, casualty requires the insertion of an esophageal King LT. An assistant is performing resuscitative measures. No cervical spine injury is present. Necessary materials and equipment: King LT, syringe provided in kit based on size, gloves, stethoscope, and bag-valve-mask (BVM).

**Standards:** Inserted the King LT within 1 minute and successfully ventilated the casualty without causing further injury.

| ACTIONS:  | 1 / 0    |
|---|----------|
| 1. Takes or verbalizes body substance isolation.  |          |
| 2. Inspects upper airway for visible obstruction.   |          |
| 3. Directs assistant to hyperventilate the patient for a minimum of 30 seconds.   |          |
| 4. Inspects and tests equipment.  |          |
| 5. Verbalizes lubricating distal end of tube.   |          |
| 6. Performs a tongue-jaw lift.  |          |
| 7. Inserts device until color base is even with the casualty's lips.  |          |
| 8. Inflates cuffs with appropriate amount of air based on size of tube.   |          |
| 9. Directs assistant to ventilate casualty with a BVM.  |          |
| 10. Informs evaluator how tube placement would be confirmed.  |          |
| <b>Evaluator: "You see rise and fall of the chest, hear breath sounds in all four lung fields and hear no sounds over the epigastrium."</b> | <b>X</b> |
| 11. Secures device to the casualty.   |          |
| TOTAL:  |          |
| TOTAL POSSIBLE:   | 11       |

## CRITICAL CRITERIA

- Failed to take body substance isolation precautions.
- Failed to inserts the King LT at the proper depth or place within 3 attempts.
- Fail to test or properly inflate the cuffs once device was inserted.
- Failed to confirm tube placement.
- Caused further injury to the patient
- Failed to perform step 2 through 9 in 1 minute.

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## EMERGENCY CRICOTHYROTOMY



**Conditions:** In the tactical field care phase of treatment, a casualty has an upper airway obstruction. The casualty's airway cannot be opened using manual methods or an endotracheal (ET) tube. Necessary materials and equipment: cutting instrument (scalpel, knife blade), alcohol pad, cannula (noncollapsible tube to maintain airway), knife handle, exam gloves, and tape, and a 4 x 4 gauze pad.

**Standards:** Established an emergency airway without causing unnecessary injury to the casualty in less than 2 minutes.

| ACTIONS:  | 1 / 0    |
|---|----------|
| 1. Takes or verbalizes body substance isolation.  |          |
| 2. Identifies the cricothyroid membrane between the cricoid and thyroid cartilages.   |          |
| 3. Cleans the site with alcohol & povidone pad.   |          |
| 4. Verbalizes use of 1% lidocaine for local anesthesia if patient is conscious.   |          |
| 5. Stabilizes the larynx with non-dominant hand.  |          |
| 6. Makes a 1 ½ inch vertical incision through the skin over the cricothyroid membrane.  |          |
| 7. Uses scalpel to cut or poke through the cricothyroid membrane and opens the incision site.                                   |          |
| 8. Maintain the opening in the cricothyroid membrane by using a hemostat or trach hook to visualize the opening of the trachea. |          |
| 9. Inserted the end of the ET tube into the trachea and directs towards the lungs at the proper depth.                          |          |
| 10. Inflates the cuff with 10 cc.   |          |
| 11. Directs assistant to ventilate casualty with a BVM if necessary.  |          |
| 12. Informs evaluator how tube placement would be confirmed.  |          |
| <b>Evaluator: "You see rise and fall of the chest and hear breath sounds in all four lung fields."</b>                          | <b>X</b> |
| 13. Secure the tube to the casualty   |          |
| 14. Applied a dressing to further secure the tube.  |          |
| TOTAL:  |          |
| TOTAL POSSIBLE:   | 14       |

### CRITICAL CRITERIA

Failed to take body substance isolation precautions.

Makes anything other than a vertical incision.

Improperly places tube in the trachea - either wrong direction, too deep or too shallow.

Caused further injury to the patient

Failed to perform steps 2 through 11 in less than 2 minutes.

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## IV ACCESS AND FLUID INITIATION



**Conditions:** In the tactical field care phase of treatment, you have a patient requiring venous access and fluid resuscitation. Necessary materials and equipment: IV administration set, IV solution, 2-18 gauge catheter-over-needle, 18 gauge needle, 5cc syringe, saline lock, constricting band, antiseptic sponges, 2 x 2 gauze sponges, tape, large tegaderm, IV stand or substitute, eye protection, and gloves.

**Standards:** Initiated an intravenous infusion without causing further injury or unnecessary discomfort to the patient. Did not violate aseptic technique and achieved venous access in less than 5 minutes

| ACTIONS:  | 1 / 0    |
|---|----------|
| 1. Gathers and inspects equipment.  |          |
| 2. Applies constricting band.   |          |
| 3. Dons gloves and cleans site.   |          |
| 4. Hold skin taut over site of venipuncture with non-dominant hand.   |          |
| 5. Holds needle at a 20-30 degree angle, bevel up, parallel to the vein over venipuncture site.                                       |          |
| 6. Pierces skin and advances needle/catheter until blood is visualized in the flash chamber.  |          |
| 7. Decreases the angle of the needle/catheter to 10-15 degree and advances 1/8 of an inch.  |          |
| 8. Advances the catheter until the hub touches the skin or until significant resistance is felt.                                      |          |
| 9. Releases the constricting band with the non-dominant hand.   |          |
| 10. Occludes the vein with the non-dominate hand.   |          |
| 11. Removes the needle and places it in a sharps container.   |          |
| 12. Insert a saline lock into the catheter hub and secures in place.  |          |
| 13. Covers both the hub and saline lock with a transparent dressing.  |          |
| 14. Flushes site with 5cc of sterile IV solution.   |          |
| <b>Evaluator: "What would be your two indications to initiate fluid resuscitation?"</b>   | <b>X</b> |
| 15. Verbalizes fluid resuscitation would begin when casualty shows signs of an altered mental status and weak or absent radial pulse. |          |
| <b>Evaluator: "Casualties carotid pulse is present, radial pulse absent"</b>  | <b>X</b> |
| 16. Collects additional equipment necessary for fluid resuscitation.  |          |
| 17. Spikes IV bag, properly prepares IV tubing and cleanses site.   |          |
| 18. Introduces needle/catheter into the saline lock.  |          |
| 19. Occludes the vein with the non-dominant hand.   |          |
| 20. Removes the needle and places it in a sharps container.   |          |
| 21. Connect IV tubing and initiates flow of fluids.   |          |
| 22. Secures tube to the casualty and checks for infiltration.   |          |
| TOTAL:  |          |
| TOTAL POSSIBLE:   | 22       |

### CRITICAL CRITERIA

Failed to take body substance isolation precautions.  
 Failed to obtain vascular access.  
 Failed to identify indications of fluid resuscitation.  
 Caused further injury to the patient  
 Failed to perform steps 4-13 in less than 5 minutes

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## F.A.S.T. 1 STERNAL INTEROSSEOUS



**Conditions:** In the tactical field care phase of treatment, you have a stable patient in need of intravenous fluid resuscitation. An IV has been attempted twice and cannot be established. Necessary materials and equipment: FAST 1 sternal intraosseous infusion set antiseptic sponges, 2 x 2 gauze, 3 inch tape, and gloves.

**Standards:** Initiated an intraosseous infusion without causing further injury or unnecessary discomfort to the patient in less than 3 minutes. Did not violate aseptic technique.

| ACTIONS:   | 1 / 0    |
|--|----------|
| 1. Gathers and inspects equipment.   |          |
| 2. Takes or verbalizes body substance isolation.   |          |
| 3. Cleanses site.  |          |
| 4. Locates suprasternal notch landmark.  |          |
| 5. Places target patch at landmark.  |          |
| 6. Rechecks the location of the target patch.  |          |
| 7. Places bone needle cluster into the target zone of the target patch. Maintains perpendicular aspect of the introducer to the sternal surface. |          |
| 8. Applies increasing pressure along introducer axis until release is felt and heard.  |          |
| 9. Gently removes the introducer by pulling straight back.   |          |
| <b>Evaluator: "You have a return of bone marrow in the infusion tube."</b>   | <b>X</b> |
| 10. Connects the infusion tube to the right angle connector on the target patch .  |          |
| 11. Connects syringe and flushes the infusion tube with 1mL of sterile solution.   |          |
| 12. Connects the IV infusion tubing, opened IV line.   |          |
| 13. Attaches the protective dome to target patch.  |          |
| 14. Attaches and ships the remover with the casualty.  |          |
| TOTAL:   |          |
| TOTAL POSSIBLE:  | 14       |

### CRITICAL CRITERIA

Failed to take body substance isolation precautions.

Failed to locate the sternal notch.

Failed to keep introducer perpendicular to the sternal surface.

Applied pressure along the introducer with extreme force, twisting or jabbing motions.

Failed to attach the remover to the casualty.

Caused further injury to the patient

Failed to establish access in less than 3 minutes.

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# TACTICAL COMBAT CASUALTY CARE ASSESSMENT



**Conditions:** While in the tactical field care phase of treatment, you are brought a casualty with multiple injuries with varying stages of treatment. You are not in an NBC environment. You have a tactical medical backpack, an M4 carbine, ballistic helmet, and individual body armor with ballistic armor plates and individual first aid kit (IFAK)

**Standards:** Assessed the casualty, identified all life threatening injuries, and treated them appropriately without causing further injury. Performed the assessments in the correct order and identified and treated all life-threatening injuries in the first 5 minutes.

| ACTIONS:   | 1 / 0 |
|--|-------|
| 1. Verbalizes appropriate steps conducted during care under fire phase of treatment.   |       |
| 2. Takes or verbalizes body substance isolation.   |       |
| 3. Determines responsiveness and chief complaint / mechanism of injury.  |       |
| 4. Reassess prior interventions completed during care under fire phase.  |       |
| 5. Assess for major life threatening hemorrhage with complete blood sweep, using appropriate measures to control bleeding.                                     |       |
| 6. Expose and treat any injury found during complete blood sweep.  |       |
| 7. Assess Airway - Patency and Insert Adjunct (1 point for each - if adjunct not necessary award 1 point = total of 2.)  |       |
| 8. Assess Breathing - Inspect, Palpate, and pulse oxymetry (1 point for each = total of 3.)  |       |
| 9. Perform needle chest decompression as necessary.  |       |
| 10. Assess Circulation - Assess central and peripheral pulse.  |       |
| 11. Initiates saline lock if casualty has a significant injury.  |       |
| 12. Begins fluid resuscitation with hextend (if appropriate, award 1 point if not indicated.)  |       |
| 13. Identify need for MEDEVAC and verbalize proper triage and MEDEVAC category   |       |
| 14. Conduct head to toe sweep for additional wounds and dress appropriately.   |       |
| 15. Reassess as necessary for tourniquet removal.  |       |
| 16. Verbalize patient taking combat pill pack or consider pain management for patients unable to ingest oral medication.                                       |       |
| 17. Apply appropriate splints to extremity injuries as necessary.  |       |
| 18. Administer appropriate antibiotic as indicated by patient injury and level of consciousness.   |       |
| 19. Verbalize initiation of a Field Medical Card.  |       |
| 20. Verbalize obtaining a full set of vital signs.   |       |
| 21. Verbalize eliciting an AMPLE History.  |       |
| 22. Verbalizes reassuring the patient during the assessment.   |       |
| 23. Verbalizes proper packaging of the patient and transport including prevention of hypothermia and continued reassessment of interventions prior to handoff. |       |
| TOTAL:   |       |
| TOTAL POSSIBLE:  | 23    |

## CRITICAL CRITERIA

Failed to take body substance isolation precautions.

Failed to assess, identify and treat life threatening conditions of Airway, Breathing or Circulation.

Completes head to toe assessment before checking Airway, Breathing and Circulation.

Failed to identify the need for fluid resuscitation.

Caused further injury to the patient

Failed to identify and treat life-threatening injuries in 5 minutes.

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## EMERGENCY TRAUMA BANDAGE



**Conditions:** In the tactical field care phase of treatment, you have encountered a casualty who is bleeding externally from an extremity. Tourniquet application is not appropriate for the situation. Materials required: emergency trauma dressing, kerlix, 3 inch tape, and exam gloves.

**Standards:** Control bleeding without further harming the casualty.

| ACTIONS:   | 1 / 0    |
|--|----------|
| 1. Takes or verbalizes body substance isolation.   |          |
| 2. Exposes the wound.  |          |
| 3. Packs the wound with kerlix or other sterile dressing (if necessary) (Award 1 point if not required). |          |
| 4. Places white portion of the dressing down covering all of the wound.                                  |          |
| 5. Wraps the elastic portion of the bandage around the extremity.  |          |
| 6. Inserts elastic wrap into the pressure bar.   |          |
| 7. Pulls bandage in opposite direction, applying pressure, with the pressure bar, over the wound.        |          |
| 8. Continues to wrap the wound tightly ensuring all edges of the wound pad are covered.                  |          |
| 9. Secures the closure bar to the bandage.   |          |
| <b>Evaluator: "Prepare the patient for transport."</b>   | <b>X</b> |
| 10. Secure the ETB with tape.  |          |
| TOTAL:   |          |
| TOTAL POSSIBLE:  | 10       |

### CRITICAL CRITERIA

Failed to take body substance isolation precautions.

Failed to pack the wound.

Failed to cover all of the wound with wound pad.

Dressing failed to have a pressure effect.

Failed to secure the bandage tightly to the extremity.

Caused further injury to the patient

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# COMBAT APPLICATION TOURNIQUET



**Conditions:** While in a tactical environment under direct enemy fire, you encounter a casualty with life-threatening bleeding from an extremity. You have a tactical medical backpack, an M4 carbine, ballistic helmet, and individual body armor with ballistic armor plates, and a fully stocked individual first aid kit (IFAK)

**Standards:** Stop life threatening hemorrhage with a combat application tourniquet within 60 seconds of encountering the patient.

| ACTIONS:  | 1 / 0    |
|---|----------|
| <b>Evaluator: "You come across the casualty suffering from life-threatening bleeding from the (arm or leg), control hemorrhage."</b>              | <b>X</b> |
| 1. Return fire.   |          |
| <b>Evaluator: "Enemy fire has been suppressed. It is safe to begin medical treatment."</b>  | <b>X</b> |
| 2. Takes or verbalizes body substance isolation.  |          |
| 3. Exposes the wound enough to ensure the tourniquet is placed above the injury   |          |
| 4. Places CAT between the heart and the wound on the injured extremity 2-4 in. above wound  |          |
| 5. Pulls the free end of the self adhering band through the buckle and route through the friction adapter buckle. (Not necessary on an arm wound) |          |
| 6. Pulls the self adhering band tight around the extremity and fastens it back on itself.   |          |
| 7. Twist the windless until the bleeding stops.   |          |
| <b>Evaluator: "Hemorrhage has been controlled."</b>   | <b>X</b> |
| 8. Locks the rod in place within the windless clip.   |          |
| 9. Secures the windless with the windless strap.  |          |
| 10. Places a "T" and the time of application on the casualty's forehead or on securing tape.  |          |
| <b>Evaluator: "Prepare the tourniquet for transport."</b>   | <b>X</b> |
| 11. Secures the CAT in place with tape.   |          |
| TOTAL:  |          |
| TOTAL POSSIBLE:   | 11       |

## CRITICAL CRITERIA

- Failed to take body substance isolation precautions.
- Placed the tourniquet less than 2 inches from the wound.
- Placed the tourniquet on a joint.
- Application of tourniquet was not effective to stop bleeding.
- Does not mark the casualty's forehead with T and time of application.
- Caused further injury to the patient
- Fails to complete steps 2 through 6 in less than 60 seconds

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# IMPROVISED TOURNIQUET



**Conditions:** While in a tactical environment under direct enemy fire, you encounter a casualty with life-threatening bleeding from an extremity. You have a tactical medical backpack, an M4 carbine, ballistic helmet, and individual body armor with ballistic armor plates, 3 inch tape, 2-cravats, and a windless devise.

**Standards:** Stopped life threatening hemorrhage with an improvised tourniquet within 90 seconds of encountering the patient.

| ACTIONS:   | 1 / 0 |
|--|-------|
| Evaluator: "You come across the casualty suffering from life-threatening bleeding from the (arm or leg), control hemorrhage."                            | X     |
| 1. Return fire.  |       |
| Evaluator: "Enemy fire has been suppressed. It is safe to begin medical treatment."  | X     |
| 2. Prepares equipment (see note below*)  |       |
| 3. Takes or verbalizes body substance isolation.   |       |
| 4. Exposes the wound enough to ensure the tourniquet is placed above the injury  |       |
| 5. Places the prepared cravat and windless between the heart and the wound and secures the cravat tightly against the extremity and ties a half knot,    |       |
| 6. Places the windlass device on the half knot, then ties a full non-slip knot over the windlass.  |       |
| 7. Twist the windless until the bleeding stops.  |       |
| Evaluator: "Hemorrhage has been controlled."   | X     |
| 8. While holding tension on the windless, places the windless inside the half knot of the second cravat.   |       |
| 9. Tightens second cravat around windless and secures the second cravat to the extremity with a full non-slip knot.                                      |       |
| 10. Places a "T" and the time of application on the casualty's forehead.   |       |
| Evaluator: "Prepare the tourniquet for transport."   | X     |
| 11. Secures the tourniquet in place with tape.   |       |
| *Tourniquets may be prepared prior to testing by securing a minimum of 8 taped tongue depressors with a full nonslip knot centered on a standard cravat. |       |
| TOTAL:   |       |
| TOTAL POSSIBLE:  | 11    |

## CRITICAL CRITERIA

Failed to take body substance isolation precautions.

Placed the tourniquet less than 2 inches from the wound.

Placed the tourniquet on a joint.

Application of tourniquet was not effective to stop bleeding (or is tied with a slip knot.)

Does not mark the casualty's forehead with T and time of application.

Caused further injury to the patient

Fails to complete steps 2 through 5 in less than 90 seconds



## NEEDLE CHEST DECOMPRESSION



**Conditions:** In the tactical field care phase of treatment, you have a conscious, breathing chest casualty with penetrating chest trauma and progressive respiratory distress who requires needle decompression. Necessary materials and equipment: stethoscope, large bore needle (10 to 14 gauge, 3-1/4 inch long) alcohol swab, and exam gloves.

**Standards:** Completed all the steps necessary to perform a needle chest decompression in order, without causing unnecessary injury to the casualty.

| ACTIONS:  | 1 / 0    |
|---|----------|
| 1. Takes or verbalizes body substance isolation.  |          |
| 2. Assesses the patient to make sure that condition is due to progressive respiratory distress secondary to a penetrating chest wound |          |
| 3. Identifies 2d intercostal space at the midclavicular line on the injured side. Verbalize alternate sites if 2nd ICS not available  |          |
| 4. Quickly prepare the area with an antiseptic solution.  |          |
| 5. Choose appropriate size and length needle catheter.  |          |
| 6. Remove back cap from needle catheter.  |          |
| 7. Properly insert needle at a 90 degree angle to the chest wall, over the top of the rib.  |          |
| 8. Ensure needle enters the pleural space (ensure pop or hiss of air)   |          |
| <b>Evaluator: "At this time you hear a hiss of air coming from the needle catheter."</b>  | <b>X</b> |
| 9. Remove needle leaving the catheter in place.   |          |
| 10. Secure the catheter hub to chest.   |          |
| 11. Place casualty in sitting position or injured side down in the recovery position.   |          |
| 12. Verbalize continued reassessment of casualty for reoccurrence of respiratory distress.  |          |
| TOTAL:  |          |
| TOTAL POSSIBLE:   | 12       |

### CRITICAL CRITERIA

Failed to take body substance isolation precautions.

Failed to recognize progressive respiratory distress secondary to penetrating chest trauma.

Failed to place needle in appropriate location based on the wound location.

Failed to select appropriate gauge and size needle catheter.

Caused further injury to the patient

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*Medical Skills  
Proficiency  
Training*  
  
7 March 2007

**Ft. Sam 91 Whiskey Combat Medic  
Medical Simulation Training  
Quantitative Integration Enhancement  
Program**


**Paul Phrampus, MD**

**1 Apr 05 – 28 Oct 08**

**\$1,668,000**

*7 March 2007*

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PLR  
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7 March 2007

**Problem to be Solved**

- Evaluate and gather benchmark performance data on 91W trainees at the DCMT to allow:
  - Performance assessment by DCMT company
  - Comparison to existing 91W medics (National Training Center (NTC) study group)
  - Address re-training needs of existing medics
  - Help DCMT leadership modify the 91W curriculum as needed

2



PLR

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3

## Problem to be Solved

- 91W training leadership desires trainee benchmark performance criteria in treatment of several key medical conditions
- 91W leadership requests performance criteria at the company level
- Evaluate experience as a factor in the re-training needs for 91W
- **Feedback** to DCMT leadership on performance of **existing 91W** to allow program modifications



PLR

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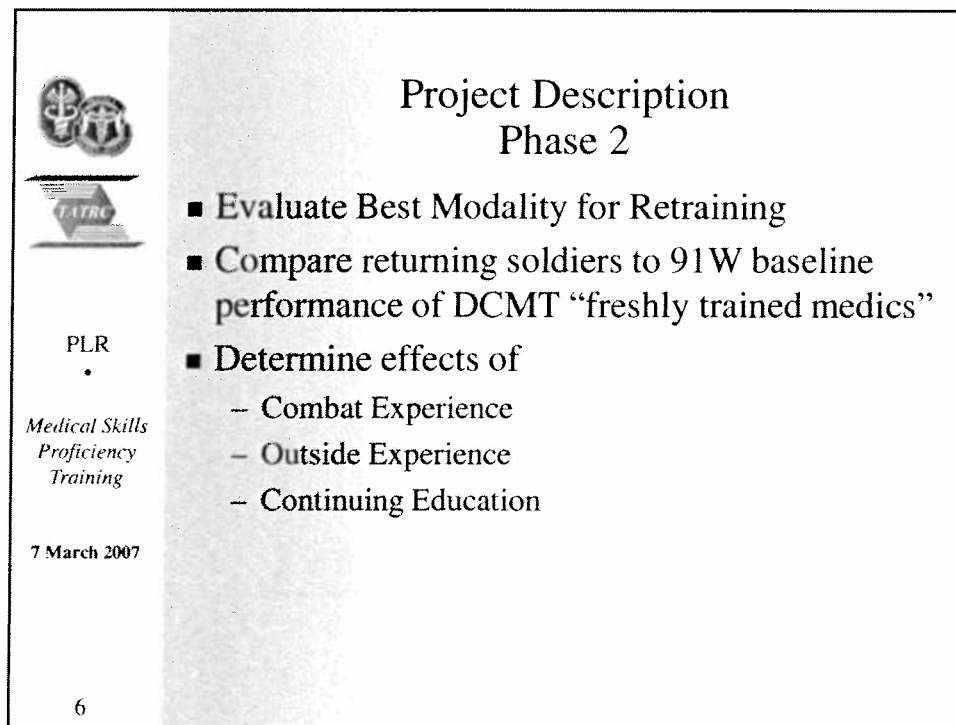
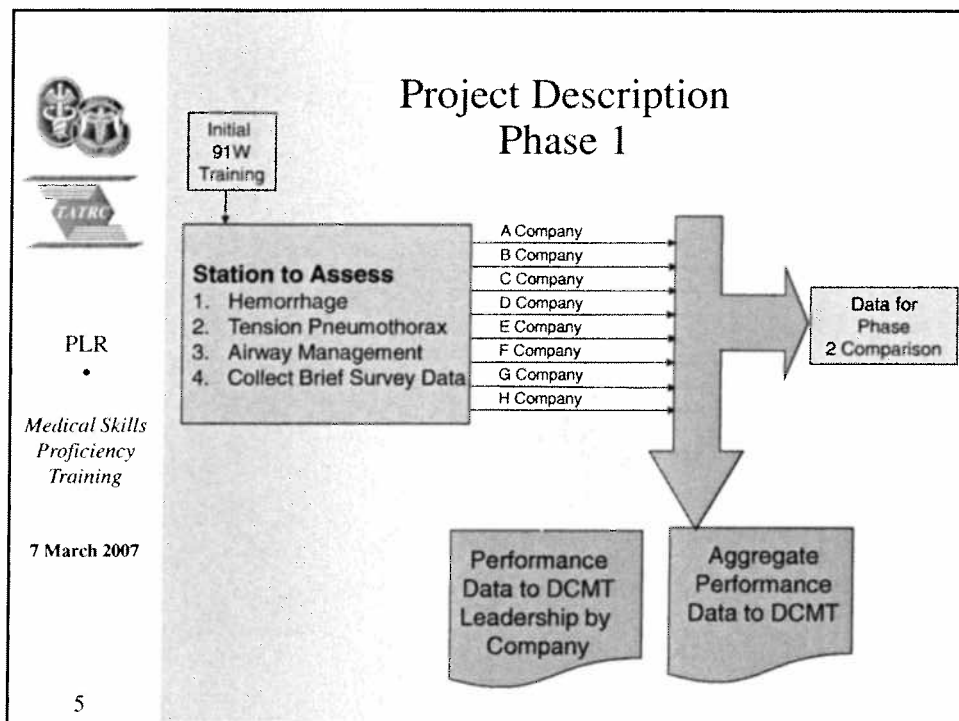
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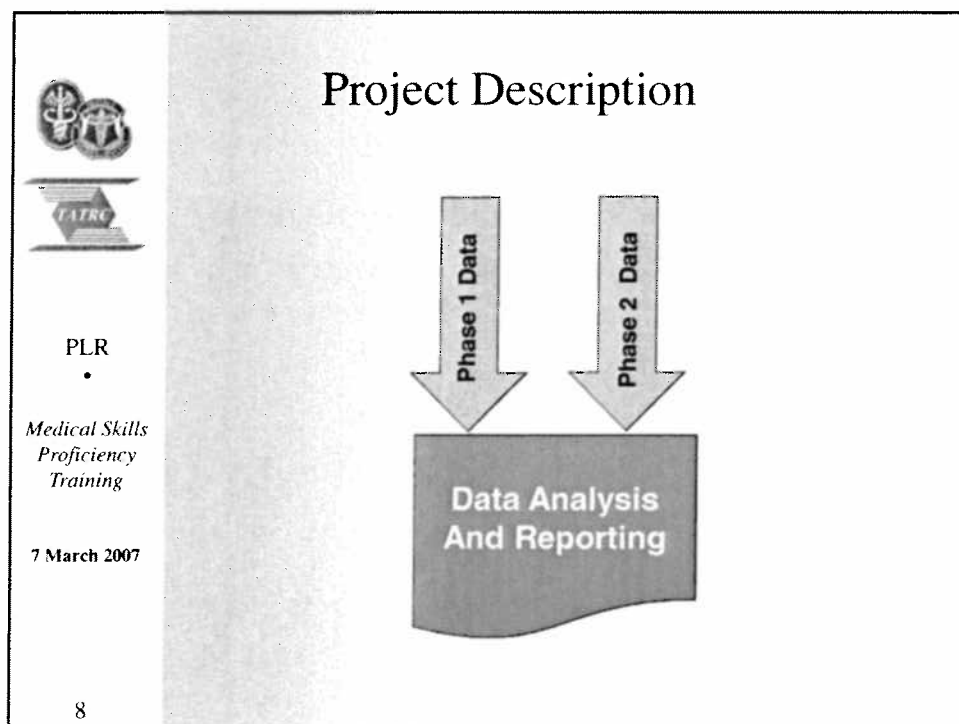
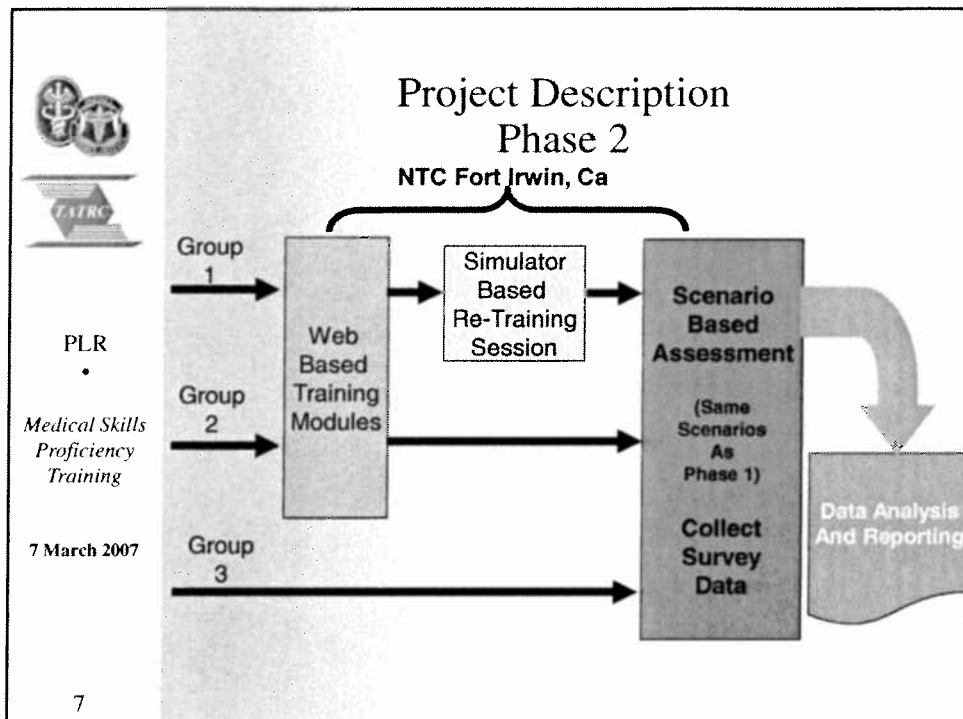
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## Solution

- At DCMT establish performance benchmark for diagnosis and treatment of
  - Airway Management Problems
  - Hemorrhage
  - Tension Pneumothorax
- At NTC establish performance data on existing medics on the same scenarios, AND query medics on their experience
- Compare Data









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## Validation Strategy

- Scenario design and performance measures will utilize existing Army curriculum
- Scenario design and performance measures designed with DCMT and NTC (medical) leadership



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Training*

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## Successes to Date

- Project design in conjunction with DCMT & NTC medical leadership
- Technical interchange meeting with DCMT leadership and NTC leadership to ensure favorable
  - Value
  - Operational Logistics



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## Challenges

- Former proposed project deemed to likely to impede operations at Fort Sam
- Required entire proposal re-write and re-approval process
- Current study design details do not impede operational missions at Ft Sam and NTC
- Lack of contractor availability at NTC
- Personnel duty obligations and turnover



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## What Next

- Currently authoring new IRB protocol submission
- Putting subcontracts into place
- Meet with DCMT leadership for details of scenario design and performance measures
- Site visit at NTC to gain insight on operations logistics



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## Compare Competing Solutions

- Not applicable
- Not proposing competitive product



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## Intellectual Property / Publications Deriving from this Project

- None at present



## Transition/ Business/ Marketing/ Plan

- Not applicable

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## Project Funding

| <u>Current Budget</u> | <u>Expended Funds</u> | <u>%</u> |
|-----------------------|-----------------------|----------|
| \$1,668,000           | \$ 151,109            | 9%       |

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Training*

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## **Additional Project Information**

**Lab/Company/Group:** University of Pittsburgh  
Medical Center, Winter Institute for Simulation,  
Education and Research (WISER)

**Principal Investigator:** Paul Phrampus, MD

**Government COR:** Harvey Magee

**Government Project Officer:** Harvey Magee

**Contract Instrument:** Cooperative Agreement

**Period of Performance:** 1 Apr 05 – 28 Oct 08

**Contract Specialist:** Juanita Bourne

**Date Initiated:** 1 Apr 05

**EDMS# :** 2676

**Contract #:** W81XWH0520049



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1

# **Ft. Sam 68 Whiskey Combat Medic Medical Simulation Training Quantitative Integration Enhancement Program**

**Tom Dongilli**

**Dir. Of Operations, WISER**

**2/23/2009 – 2/22/2010**

**\$1,658,000**

**Congressional Appropriation**



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2

## **Military relevant issue to be solved**

- Evaluate and gather benchmark performance data on 68W trainees at the DCMT to allow:
  - Comparison to experienced 68W medics
  - Address re-training needs of experienced medics
- Help DCMT leadership modify the 68W curriculum as needed



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## Military relevant issue to be solved

- 68W training leadership desires trainee benchmark performance criteria in treatment of several key medical conditions
- Evaluate experience as a factor in the re-training needs for 68W
- Feedback to DCMT leadership on performance of existing 68W to allow program modifications



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## Solution

- At DCMT establish performance benchmark for diagnosis and treatment of
  - Airway Management Problems
  - Hemorrhage
  - Tension Pneumothorax
- Establish performance data on experienced medics on the same scenarios, AND query medics on their experience
- Compare Data



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## Assessment Station Setup



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## Project Description Phase 1 Camp Bullis



Initial  
68W  
Training

**Station to Assess**  
1. Hemorrhage  
2. Tension Pneumothorax  
3. Airway Management

Data for  
Phase  
2 Comparison

Report  
Data to DCMT



**Product Line Review (PLR) Meeting**

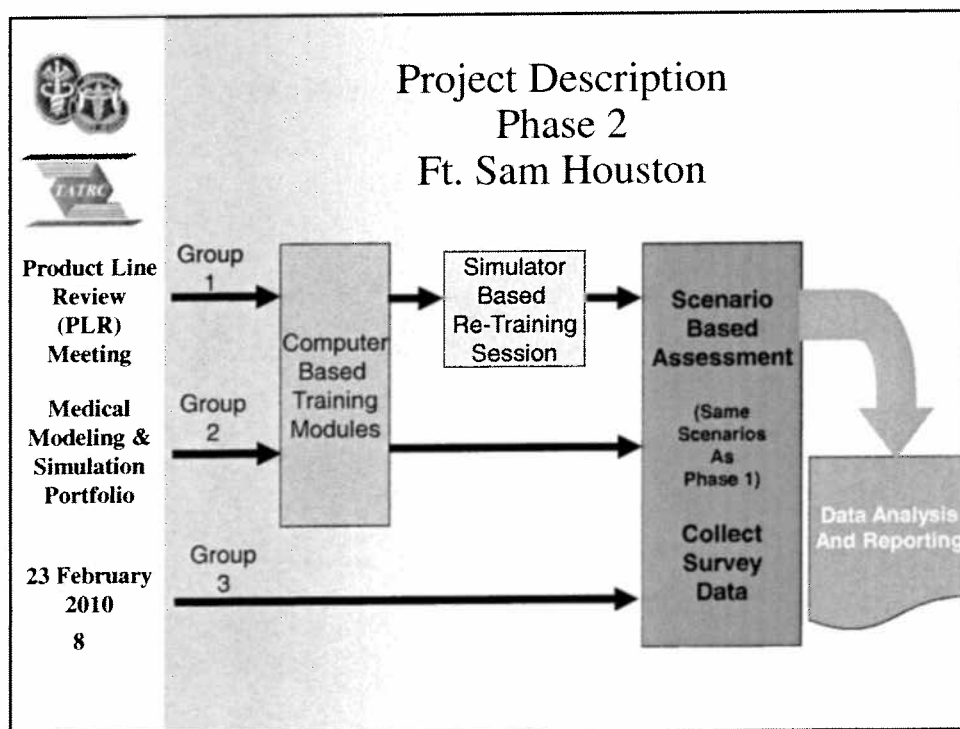
**Medical Modeling & Simulation Portfolio**

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## Project Description Phase 2

- Evaluate Best Modality for Retraining
- Compare experienced medics to 68W baseline performance of DCMT “freshly trained medics”
- Determine effects of
  - Combat Experience
  - Outside Experience
  - Continuing Education





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## Assessment Run



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## Assessment checklist

- ☐ GENERAL ASSESSMENT
  - 1. Take Isolation Precautions
  - 2. Determine Responsiveness
  - 3. Assess For Major Life-Threatening Injury
  - 4. Identify and Expose Injuries
  - 5. Assess ABC's
  - 6. Assess Central and Peripheral Pulses
  - 7. Initiate Saline Lock if Indicated
  - 8. Begin Fluid Resuscitation
  - 9. Conduct Head-to-Toe Sweep
  - 10. Consider Plan Management
- ☐ PNEUMOTHORAX
- ☐ AIRWAY
- ☐ HEMORRHAGE
  - ☐ 1. General
    - 1. Assures Scene is Secure
    - 2. Don Goggles
    - 3. Verbalizes Body Substance Isolation
    - 4. Performs Quick Assessment
    - 5. Exposes Wound 2-4 inches Above Injury Site
  - ☐ 2. I&IV
    - 1. Performs IO
    - 2. Starts IO Infusion
    - 3. Starts IV
    - 4. Starts IV Infusion
  - ☐ 3. Triage Bandage
    - 1. Pack Wound with Telfa
    - 2. Place White Portion of Bandage Around Extremity
    - 3. Apply Firm Pressure



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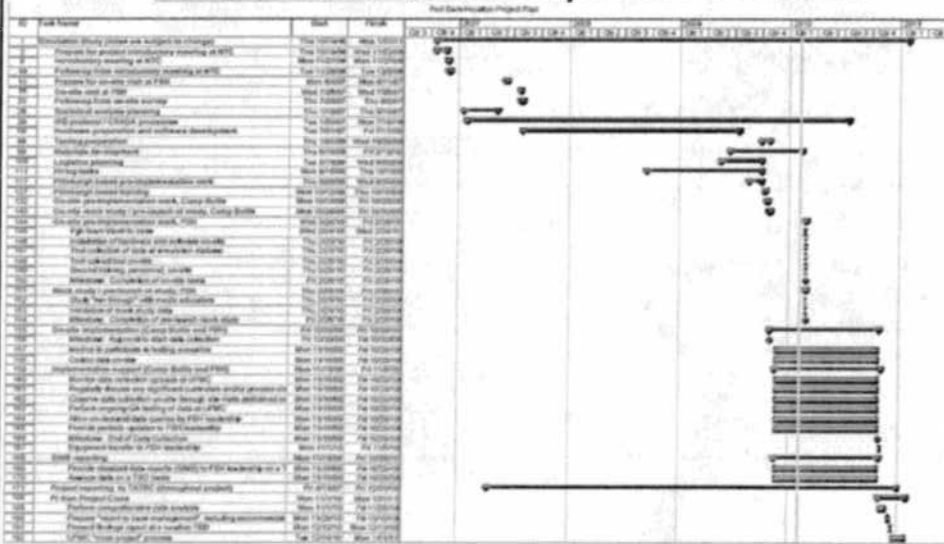
## Validation Strategy

- Scenario design and performance measures will utilize existing Army curriculum
- Scenario design and performance measures designed with DCMT leadership
- We will have independent expert reviewers assess randomly selected videos and score the performance of the medics. We will then compare those scores to the ones completed by the study facilitators



*Include detailed timeline/Gantt chart*

## Research/Development Timeline





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## Successes to Date

- Establishment of assessment locations at Camp Bullis and Ft. Sam Houston
- Data collection at Camp Bullis
- Data collection starts this week at Ft. Sam Houston
- Preliminary data loaded into analysis system



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## Challenges

- Phase II research candidates due to restricted scheduling
- Overcoming wireless network connectivity at Camp Bullis



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## What's Next

- Continue to collect data at Camp Bullis
- Start to collect data at Ft. Sam Houston
- Refine process at Ft. Sam Houston
- Continue with data quality assurance from both sites
- Start preliminary data analysis
- Report to leadership at Ft. Sam Houston & Camp Bullis



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## Compare Competing Solutions

We don't know of any at this time



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## **Intellectual Property / Publications Deriving from this Project**

No confidentiality agreements, inventions, or patents have been applied for from this project

No publications have been submitted yet, though there are plans to do so this year.



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## **Transition/ Business/ Marketing Plan**

Not applicable



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## Project Funding

| <u>Current Budget</u> | <u>Expended Funds</u> | <u>%</u> |
|-----------------------|-----------------------|----------|
| \$1,658,000           | \$730,180             | 44%      |



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## Additional Project Information

Lab/Company/Group: University of Pittsburgh  
Medical Center

Principal Investigator: Dr. Paul Phrampus

Government COR: Harvey Magee

Government Project Officer: Jason Ghannadian

Contract Instrument: Cooperative Agreement

Period of Performance: Apr 2005 to Jan 2011

Contract Specialist: Juanita Bourne

EDMS# : 2676

Contract #: W81XWH0520049

**Performance assessment of novice and experienced combat medics using simulation-of three critical combat casualty lifesaving skills.**

Paul E. Phrampus, MD\*‡

Benjamin W. Berg, MD†

John W. Lutz, BS\*

V. Terri Collin, PhD#

Thomas A. Dongilli\*

Maj. Robert L. Mabry, MD††

*From the Peter M. Winter Institute for Simulation Education and Research (WISER)\*, University of Pittsburgh School of Medicine, Departments of Anesthesiology and Surgery‡, University of Pittsburgh Medical Center; SimTiki Simulation Center, Telehealth Research Institute, John A. Burns School of Medicine, University of Hawaii at Manoa†; US Army Department of Combat Medic Training, Ft Sam Houston, San Antonio TX††. Division of Internal Medicine Center for Research on Health Care Data Center University of Pittsburgh#.*

*Supported by a Cooperative Research and Development Agreement with the U.S. Army, Contract #W81XWH0520049.*

**Address for correspondence:** Paul E. Phrampus, MD, Director, Peter M. Winter Institute for Simulation Education and Research (WISER), 230 McKee Place, Suite 300, Pittsburgh, PA 15213 USA (412) 648-6073, phrampuspe@upmc.edu.

**ABSTRACT**

**Study objectives:** 1) Assess Combat Medic training processes by evaluating trainee critical skills performance in simulated hemorrhage control, airway management and pneumothorax decompression. 2) Compare skills of novice Medics to those of experienced Medics to assess durability of primary training; 3) Compare enhanced refresher training techniques for experienced Medics, using video review and mannequin training vs. standard didactic refresher training; and 4) Examine potential predictor demographics for critical skills performance.

**Methods:** In Phase I, a convenience sample of 399 newly trained combat medics completed mannequin based critical skills evaluation. In Phase II, 205 experienced medics were evaluated. Critical skills were assessed using checklists and time to completion of critical actions during standardized mannequin scenarios. Educational interventions, were evaluated in Phase II by providing 3 groups of experienced medics pre-critical skill testing review including; a.) standard training curriculum, or b.) standard training curriculum + enhanced training with skill specific instructional videos; or c.) standard training curriculum + enhanced training with skill specific instructional videos + hands-on simulator skill practice.

**Results:** Experienced medics performed procedures faster than novices. Within the group of experienced medics, the control group completed procedures faster than the intervention group. With two exceptions, both newly trained and experienced medics achieved benchmark times derived from military references. Multiple regression



analyses showed none of the selected demographic or experience variables accounted for variability in performance.

**Conclusions:** Existing simulation-based training in three procedures tested achieves clinically acceptable performance standards. The established time to completion standards should be critically appraised and new standards established based on population performance metrics. Initial training skill levels endure in experienced combat medics without extensive retraining. Enhanced refresher training with video and or simulation does not appear to significantly improve performance.

## INTRODUCTION

**Background:** The top three causes of preventable battlefield death are *airway obstruction, uncontrolled hemorrhage* (usually from extremity wounds) and *tension pneumothorax*<sup>1</sup>. These life threatening injuries often are caused by explosive munitions, which account for more than half of all combat-related injuries sustained by U.S. troops<sup>2</sup>.

- *Uncontrolled hemorrhage* is the leading cause of preventable combat-related deaths.<sup>3</sup> Data from the Vietnam conflict suggest that 50% of battlefield casualties died of exsanguination within three to five minutes and could have been salvaged with timely intervention.<sup>4</sup> In combat, severe hemorrhage often results from limb amputation caused by proximity to the detonation site of an Improvised Explosive Device (IED).
- *Tension pneumothorax* is the second-leading cause of preventable death on the battlefield.<sup>5</sup> It typically presents in the context of gunshot wounds.
- *Airway obstruction* is responsible for an estimated 10% of preventable battlefield deaths.<sup>6</sup> This emergency condition may result from exposure to a blast wave but can result from accidents and numerous other causes.

**Importance:** The doctrine now known as Tactical Combat Casualty Care (TCCC) was developed because “90% of combat wound fatalities die[d] on the battlefield before reaching a medical treatment facility.”<sup>7</sup> A hallmark of the combat medic role is to provide battlefield care that includes treatment for the above three conditions, often in mass

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<sup>1</sup> “Tactical Combat Casualty Care Trainer: Student Handbook,” Field Medical Service School, Camp Pendleton, CA.

<sup>2</sup> Gawande, A. (2004). “Casualties of war – military care for the wounded from Iraq and Afghanistan,” *New England Journal of Medicine* 351, 2471-2475.

<sup>3</sup> Alam, H.B., Burris, D., DaCorta, J.A., Rhee, P. (2005). “Hemorrhage Control in the Battlefield – Role of New Hemostatic Agents,” *Military Medicine* 170 (1), 63-69(7).

<sup>4</sup> “Combat Lifesaver Course: Student Handbook,” rev. June 2006, Field Medical Service School, Camp Pendleton, CA, and “CLS Program Updates,” (recertification edition C), December 2009.

<sup>5</sup> Combat Lifesaver Course, Ibid.

<sup>6</sup> Berg, B.W., Vincent, D.S., Murray, W.B., Boedeker, B.H. (2009). “Videolaryngoscopy for intubation skills training of novice military airway managers,” *Studies in Health Technology and Informatics* 142, 34-6.

<sup>7</sup>TCCC Trainer, Ibid.

casualty scenarios, while under enemy fire and during preparations for evacuation.<sup>8</sup> Thus, fluency and automaticity in performing lifesaving procedures is essential.

In addition to demands on individual soldiers, there are demands on the Department of Defense to rapidly and effectively train military medical professionals. In San Antonio, the Army Department of Combat Medic Training (DCMT) provides initial CFM training to about 7,000 individuals per year and refresher training to roughly 500 experienced combat medics per year.

**Goals:** The purpose of the present study is to explore the effects of experience on the performance outcomes of student and experienced CFM and to examine any significant differences between student and experienced CFM. The research team tested two principle hypotheses: 1. Experienced medics will correctly implement lifesaving procedures using critical skills for each of the three simulated scenarios; traumatic limb exsanguination, tension pneumothorax and establish a patent airway in less time than newly trained medics and 2. For experienced medics, groups exposed to hands-on practice on human patient simulators will achieve the shortest mean times to correctly complete procedures compared to the control group and a group whose training is supplemented by instructional videos. In addition we sought to examine demographic factors as predictors of critical skill performance.

## BACKGROUND

Emergency medical care, which relies on procedural competence and effective decision making, team interaction and communication, utilizes tools such as simulation to optimally teach and assess proficiency. Proficiency is particularly needed in life-threatening situations to assure the health of patients and reduce errors. Simulation, born out of the aviation industry, was developed to train and assess the performance of future pilots, with the goal of reducing human error, decreasing adverse events and increasing skill in high-stress, complex, high reliability situations.<sup>1,2,3</sup> The use of simulation in reducing adverse events and providing training has expanded to multiple disciplines and has become an accepted approach to teaching effective ways of responding to real-life situations.

In high-risk and high acuity environments such as the battlefield, ensuring learners are prepared and skilled is crucial. In one study, a course on bioterrorism response<sup>2</sup> used two simulated environments, one a trauma center emergency room and the other an Operations Command Center. During one exercise learners (consisting of clinicians, paramedics, military and intelligence officers, administrators, etc.) participated in a Weapons of Mass Destruction (WMD) scenario and played roles reflecting their responsibilities. Performance of learners and perceived effectiveness of the simulation training were assessed. Faculty evaluation of students found simulation was an effective mode for assessing the actions and decision-making of learners in a high-risk simulated

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<sup>8</sup> TCCC Trainer, Ibid.

scenario. Learners reported simulation was a useful training tool and highlighted the role of simulation in providing realism and reinforcing important concepts.<sup>2</sup>

Similarly, across healthcare disciplines, simulation-based education has increasingly become an effective tool for training, re-certification and evaluation, emphasizing concepts such as error reduction; patient safety<sup>4</sup>; decision-making; competency and performance assessment.<sup>5,6,7,8</sup> Advantages of simulation include the ability to train learners in a safe and controlled environment; assess performance; provide direct feedback; highlight significant teaching points; emphasize repetitive and deliberate practice of skills; train across multiple simulated environments; and evaluate standardized outcomes.<sup>8</sup>

United States Army Combat Field Medics (CFM) are highly trained professionals who have many responsibilities, including providing emergency care to wounded soldiers on the battlefield. CFM education and training is uniquely tailored to develop skills required for effective assessment and treatment of acute traumatic injuries in combat.

Initial CFM training occurs at Camp Bullis, located in San Antonio, Texas under the Department of Combat Medical Training (DCMT). The program consists of lectures, computerized self-study, practical skills workshops, examinations and field exercises. Classes are divided into eight companies, each consisting of roughly 200 soldiers, and proceed for 14 to 16 weeks. Additionally, advanced or refresher training for experienced CFM is held in two-week sessions at Fort Sam Houston, also located in San Antonio. Six classes of experienced medics are trained each year at this location, in a course currently called Advanced Leadership Course. Participants are generally experienced CFM's with 4 years or more experience since completing initial CFM training.

In addition to the methods listed above, medical simulation plays a significant role in the Army's approach to training CFMs. Medical training employs computerized human patient simulators, moulage, partial task trainers, video simulations and static mannequins. These techniques are employed to bring the curriculum to life for trainees. Simulation methods afford the opportunity for trainees to practice hands-on procedural skills, rehearse algorithms and make decisions, as well as, practice teamwork. Simulation is also used to assess competency in specific topic areas. Some computerized patient simulators have the ability to gather data that can be quantitatively and qualitatively evaluated for individual trainees and groups of trainees. Trainee performance data collected through mannequin interactions has not been systematically used for curriculum analysis, trainee performance feedback and measurement, or other purpose in the CFM training programs.

## **METHODS**

The present study was conducted under IRB approvals from all participating and sponsoring organizations.

**Study Participants and Setting:** The study sample consisted of a convenience sample of 604 novice medics and experienced CFMs who were participating in separate Army

training programs in San Antonio, TX, during 2009 and 2010. Participants were recruited to one of two phases of the study, based on their experience level. Phase I consisted of 399 volunteer novice combat medics and Phase II consisted of 205 volunteer experienced CFM.

**Research Design:** To measure differences in performance by experience, the study proceeded in two phases.

Phase I was a descriptive study measuring the baseline performance of student CFM undergoing initial training at Camp Bullis, in San Antonio TX. Participants' performance was evaluated using established benchmarks in the DCMT curriculum for three trauma scenarios: Emergent airway management, control of life-threatening hemorrhage and treatment of tension pneumothorax. Demographic information and performance data for each of the three scenarios with a focus on one critical skill for each scenario; tourniquet placement, needle decompression of pneumothorax and establishment of a patent airway, was collected for all participating student CFM.

Phase II was an experimental study at Fort Sam Houston, TX. The effect of three different training formats on performance of experienced CFM across the same three scenarios was assessed using the same DCMT performance benchmarks and scenarios as Phase I. Participants were randomly assigned to a control group which received no scenario specific training, a video instruction group reviewed a refresher video on performance of the three critical skills, or a group receiving both video instruction and critical skills hands-on training using simulators.

**Study Procedures and Study Instrument:** In Phase I, on-site study facilitators recruited novice medics to participate in three scenarios at a dedicated assessment station during the last two weeks of their 16-week CFM training program at Camp Bullis. In Phase II, study participants visited a dedicated assessment station at any self-selected time during their two-week training. All participation was voluntary and did not interfere with ongoing Army training operations.

On-site study facilitators were two retired CFM with previous combat experience who were familiar with Army training protocols.

Research team members at the WISER Center in Pittsburgh provided facilitators with an intensive, two-week training program on use of the simulators for performance assessment. A software interface (Simulation Information Management System - SIMS® - SimMedical Inc., Pittsburgh PA) was utilized for automated collection and export of mannequin (Laerdal SimMan®, Wappingers Falls, NY) sensed student actions and training scenario data logs. SIMS was utilized to de-identify and upload performance data to a web based secure data repository.

All participants completed a written survey of basic demographic information and prior combat and civilian medic training and experience. Survey items included age, gender, years in active duty, years of experience as a CFM and years of experience as a civilian medic.

For Phase I, student participants received a standardized simulator orientation and their regularly scheduled DCMT instruction on the three trauma scenario assessment and treatment skills. (airway management, hemorrhage control and treatment of tension pneumothorax). The scenarios were performed independently in a randomized sequence. Scenarios were considered completed after all steps for successful of emergency treatment with tourniquet, needle decompression, or airway was completed, or after 5 minutes, regardless of performance or other factors.

For Phase II, experienced medic participants received a standardized simulator orientation after random assignment to one of three groups, as follows:

-- The ***control group*** received standard training provided in the DCMT curriculum. Participants in this group were presented in random sequence with the same three scenarios used in Phase I and asked to provide treatment on the simulator.

-- The second group (***video supplementation***) received standard DCMT training supplemented by instructional videos based on DCMT training benchmarks. The videos explained and illustrated proper execution of steps required to complete procedures for the three scenarios. Following videos viewing participants were assessed during sequential random order simulation scenarios.

--The third group (***video supplementation and hands-on practice on simulators***) received standard DCMT training and the standardized video instruction described above. In addition, individuals in the third group were asked to respond to the three standardized scenarios on a simulator, after which they received live instructor feedback concerning their performance. Immediately after this practice session, performance of the third group on the three scenarios was assessed on the simulator in the same order they were rehearsed.

(See ***Appendix A*** for an overview of the study process).

Three standardized scenarios were preprogrammed into the simulators to ensure that each began from the same baseline and the simulator could react identically to the same interventions from different trainees. This ensured a reliable presentation of patient data to the participant and a uniform set of expectations for facilitators who scored performance.

Performance of student and experienced CFM was evaluated in terms of time to complete procedures using actions in standardized checklists based on DCMT medical training manuals and leadership input.

The checklist items were scored by facilitators as completed or not completed. Information about key physiologic states of the simulated patient was also recorded by the simulator. For example, physiologic state changes were recorded in response to

delivery of external ventilation, or performance of chest compressions. The simulator system provided an electronically recorded time stamp for each entry recorded by the facilitator, the physiologic events sensed by the simulator and any changes to simulator vital signs. At the conclusion of the scenario, the simulator log file was saved with a unique identification (ID) number that linked the participant's performance to data in his or her demographic survey.

**Equipment:** The Laerdal SimMan™ full-scale high fidelity patient simulator, a full-body mannequin with advanced features and software, was used for simulation scenarios.

SimMan™ software allows instructors to record, store and access data used to debrief trainees. Scenario data was transferred to SIMS software database for performance analysis and reporting. The SimMan™ digital audio/visual system generates recordings of learner performance that are cross referenced and linked to time-stamped simulator events, CFM trainees at Camp Bullis and Fort Sam Houston are familiar with the SimMan™ system, 130 SimMan™ units are used during routine CFM training at DCMT.

**Date Collection and Statistical Analyses:** On-site facilitators collected all performance-related study data. The data set comprised participants' ID numbers, demographic items, time to complete procedures and performance checklists.

Data were analyzed using SPSS 17.0. Descriptive statistics were used to describe the Phase I and Phase II group demographics and performance measures (i.e., time and number of steps taken to successfully complete each scenario). Bivariate correlational analysis was also employed to determine whether any significant associations existed among dependent variables both within and between Phase I and Phase II groups. Inferential analysis was employed using Analysis of Variance (ANOVA) and multiple regression to assess both the within- and between-group differences between Phase I and II groups based on performance measures, to highlight any individual variations in performance and validate the measures used to assess performance

## RESULTS:

### Demographics

Of the 604 CFM volunteers, 399 were Phase I novice medics and 205 were Phase II experienced medics. (See Table 1 below.)

**Table 1. Demographics Phase I and Phase II**

| <i>Study Phases &amp; Group Assignments</i>             | <i>N (%)</i>      |
|---|-------------------|
| <i>Phase I</i>  | <b>399 (100%)</b> |
| <i>Phase II, Group 1 (Control)</i>                      | <b>77 (38%)</b>   |
| <i>Phase II, Group 2 (Video instruction supplement)</i> | <b>64 (31%)</b>   |
| <i>Phase II, Group 3 (Video and hands-on practice)</i>  | <b>64 (31%)</b>   |

|                     |            |
|---------------------|------------|
| <b><i>TOTAL</i></b> | <b>604</b> |
|---------------------|------------|

Of the total sample (Phases I and II combined), 91.9% had complete data for questions one through ten of the demographic questionnaire and all of the six dependent variables (airway steps, airway time, hemorrhage steps, hemorrhage time, tension pneumothorax steps and tension pneumothorax time). Questions #11-16 of the demographic questionnaire were excluded from the percentage calculated for complete information, because these questions were dependent upon a response of “Yes” to question seven. (See Table 2 below.)

**Table 2. Complete information and missing data for all Phase I and II subjects**

| <b><i>Number of missing data points</i></b> | <b><i>Number of people (N = 604)</i></b> | <b><i>Percentage</i></b> |
|---|--|--------------------------|
| 0 No missing data                           | n = 555                                  | 91.9%                    |
| 1 One missing data point                    | n = 22                                   | 3.6%                     |
| 2 Two missing data points                   | n = 22                                   | 3.6%                     |
| 3 Three missing data points                 | n = 5                                    | .8%                      |

2

A full 77.5% of the Phase I sample was between the ages of 18-25, while 75.6% of the Phase II sample was between the ages of 26-40. Of the 399 Phase I participants, 288 (72.2%) were male and 109 (27.3%) were female; similarly, for Phase II, 172 (83.9%) were male and 32 (15.6%) were female, respectively. (See Table 3 below.) For Phase I participants, 56.6% and 16.5% were active duty Army and Army reserve currently serving active duty, respectively. Of the Phase II sample, 94.1% reported active duty status.

**Table 3. Demographic characteristics and experience reported by study subjects**

| <b>Subject Characteristics</b>  | <b>Phase I<br/>Novice Medics</b> | <b>Phase II<br/>Experienced Medics</b> |
|---------------------------------|----------------------------------|--|
| <b><i>Total Sample</i></b>      | 399                              | 205                                    |
| <b><i>Age</i></b>               |                                  |  |
| 18-20                           | 209 (52.4%)                      | 4 (2.0%)                               |
| 22-25                           | 100 (25.1%)                      | 35 (17.1%)                             |
| 26-30                           | 52 (13.0%)                       | 75 (36.6%)                             |
| 31-40                           | 36 (9.0%)                        | 80 (39.0%)                             |
| 41-50                           | 1 (.3%)                          | 11 (5.4%)                              |
| No answer                       | 1 (.3%)                          | 0                                      |
| <b><i>Gender</i></b>            |                                  |  |
| Male                            | 288 (72.2%)                      | 172 (83.9%)                            |
| Female                          | 109 (27.3%)                      | 32 (15.6%)                             |
| No answer                       | 2 (.5%)                          | 1 (.5%)                                |
| <b><i>Weeks in Training</i></b> |                                  |  |
| <10                             | 2 (.6%)                          | 205 (100%)                             |

|   |             |                      |
|---|-------------|----------------------|
| 10-14   | 26 (6.7%)   | 1 week – 123 (60%)   |
| 15  | 236 (59.1%) | 2 weeks – 81 (39.5%) |
| 16  | 134 (33.6)  | 6 weeks – 1 (.5%)    |
| No answer   | 1 (.3%)     | 0                    |
| <b>Soldier Status</b>                                       |             |                      |
| Active Duty Army  | 226 (56.6%) | 193 (94.1%)          |
| Army Reserve on Reserve Training                            | 54 (13.5%)  | 7 (3.4%)             |
| Army Reserve Currently Serving Active Duty                  | 66 (16.5%)  | 2 (1.0%)             |
| None of the Above   | 51 (12.8%)  | 2 (1.0%)             |
| No answer   | 2 (.5%)     | 1 (.5%)              |
| <b>Years of Active Duty Army</b>                            |             |                      |
| <1 full year  | 368 (92.2%) | 5 (2%)               |
| 1-3 years   | 15 (4%)     | 12 (6%)              |
| 3-5 years   | 11 (2%)     | 28 (14%)             |
| 6-10 years  | 2 (1%)      | 122 (60%)            |
| 11-15 years   | 0           | 28 (14%)             |
| 16-20 years   | 0           | 9 (4%)               |
| Greater than 20 years                                       | 0           | 1 (1%)               |
| No answer   | 3 (1%)      | 0                    |
| <b>Number of Battlefield Casualties Cared for in Career</b> |             |                      |
| <10   | 372 (93%)   | 77 (38%)             |
| 11-15   | 3 (.1%)     | 32 (16%)             |
| 26-50   | 1 (.1%)     | 37 (18%)             |
| 51-100  | 1 (.1%)     | 22 (11%)             |
| 101-200   | 0           | 12 (6%)              |
| Greater than 200  | 1 (.1%)     | 20 (10%)             |
| No Answer   | 19 (5%)     | 5 (2%)               |
| <b>Experience as Civilian EMT, Paramedic or Firefighter</b> |             |                      |
| Yes   | 52 (13%)    | 45 (22%)             |
| No  | 345 (86%)   | 160 (78%)            |
| No Answer   | 2 (1%)      | 0                    |

**Descriptive Analyses:** The number of actions/steps and the amount of time taken to successfully complete each of the three scenarios were used as dependent measures. Successful completion of each of the scenarios in time was defined as follows: 1) Less than or equal to three minutes for airway management, 2) Less than or equal to 90 seconds for hemorrhage control and 3) Less than or equal to two minutes and 35 seconds for tension pneumothorax. These time parameters reflect the criteria used by the Department of Combat Medic Training Army for both Phases I and II groups, across all 3 scenarios, the number of actions/steps taken to successfully complete the scenario was significantly, positively associated with the time taken to complete the scenario. As the number of actions/steps to complete the scenario increased so did the time.



**Inferential Analyses:** Several steps were taken to analyze the differences in time and performance of checklist items between Phases I and II and within the three randomized groups for Phase II. The results are reported between Phases I and II and for Phase II only.

### *Airway*

ANOVA was performed to determine the difference in mean number of actions/steps and mean amount of time to successfully complete each of the three scenarios between Phase I (novice) participants and the three randomized groups of experienced medics in Phase II. As shown in Table 4 there were significant between-group differences ( $F = 9.80$ ,  $P < .000$ ) in number of steps taken to successfully complete the airway scenario between Phase I and Phase II participants. Specifically, employing Tukey's post-hoc test (Tukey's HSD) there were significant differences between Phase I and Phase II Group 2 (video supplementation) ( $P < .000$ ); Phase I and Phase II Group 3 (video + hands-on supplementation) ( $P < .01$ ); and Phase II control and Phase II Group 2 ( $P < .01$ ).

For time to successfully manage the airway scenario, there was a significant between-group difference ( $F = 3.33$ ,  $P < .01$ ) between Phase I (student) medics and Phase II (experienced) medics in the control group. The Phase II control group (experienced medics) were able to manage the airway in less time than Phase I participants (novice medics).

**Table 4.**  
**Airway Scenario**

(Significant between and within group differences  
are indicated by matching superscripts =  $P < 0.05$ )

| <b>Group</b>                                    | <b>Airway<br/>Number of<br/>Steps</b> | <b>Airway<br/>Total Time</b> | <b>Airway –<br/>Combitube<br/>placement<br/>time</b> | <b>Airway –<br/>King LT<br/>placement<br/>time</b> |
|---|---------------------------------------|------------------------------|--|--|
| <b>Phase I</b> (Novice medics)                  |                                       |                              |  |  |
| <b>Mean</b>                                     | 12.70** (*)                           | 203.74†                      | 107.12   | 100.05***  |
| <b>N</b>  | 374                                   | 372                          | 167  | 198  |
| <b>Std. Deviation</b>                           | 3.66                                  | 74.37                        | 53.06  | 55.59  |
| <b>Phase II</b> (Experienced<br>medics)         |                                       |                              |  |  |
| <b>Group 1:</b> Control                         |                                       |                              |  |  |
| <b>Mean</b>                                     | 13.28*(+)                             | 174.11†                      | 117.37   | 77.33***   |
| <b>N</b>  | 74                                    | 73                           | 19   | (++)   |
| <b>Std. Deviation</b>                           | 4.21                                  | 71.45                        | 57.27  | 46<br>40.67  |
| <b>Phase II</b>                                 |                                       |                              |  |  |
| <b>Group 2:</b> Video<br>supplementation        |                                       |                              |  |  |
| <b>Mean</b>                                     | 15.17***(+)                           | 194.20                       | 99.73  | 108.04(++)   |
| <b>N</b>  | 60                                    | 60                           | 15   | 45   |
| <b>Std. Deviation</b>                           | 2.57                                  | 64.39                        | 26.57  | 40.38  |
| <b>Phase II</b>                                 |                                       |                              |  |  |
| <b>Group 3:</b> Video and hands-<br>on practice |                                       |                              |  |  |
| <b>Mean</b>                                     | 14.28(*)                              | 197.93                       | 99.50  | 102.76   |
| <b>N</b>  | 58                                    | 58                           | 12   | 42   |
| <b>Std. Deviation</b>                           | 3.84                                  | 83.23                        | 52.97  | 59.10  |

Unique to the airway scenario was the choice of tools available to the CFM. Participants were given the option of using either a Combitube or a King LT tube to secure the airway, and in some cases, airway attempts were made with both devices. Overall faster completion times were associated with the King LT. Although there were no between-group differences noted for those participants who used the Combitube in either Phase I and II groups, there were significant between- group differences in the time to successfully manage the airway scenario for those participants who used the King LT ( $F=3.14$ ,  $P<.02$ ). Significant differences were noted between Phase I and Phase II control ( $P<.04$ ) and Phase II control and Phase II Group 2 (video supplementation) ( $P<.03$ ). In both cases, the Phase II control group took less time to successful manage the airway with the King LT tube than either the Phase I (student) medics or the Phase II (experienced) medics in Group 2 (video supplementation).

## *Hemorrhage*

ANOVA was performed to determine differences in the mean number of steps, mean time to apply a Combat Application Tourniquet (CAT) to the site of a simulated severe hemorrhage due to limb amputation and total time taken to successfully complete the hemorrhage scenario. As shown in Table 5, there were significant between-group differences found in the number of steps taken to successfully complete the hemorrhage scenario ( $F=23.79$ ,  $P<.00$ ). Post-hoc analyses employing Tukey's HSD revealed significant differences between Phase II control group of experienced medics and the novice medics in Phase I ( $P<.00$ ); Phase II Group 2 (video supplementation) and Phase I novice medics ( $P<.00$ ); and Phase II Group 3 (video and hands-on training) and Phase I novice medics ( $P<.00$ ).

Significant between-group differences were observed in time taken to apply a tourniquet ( $F=4.16$ ,  $P<.00$ ). Post-hoc analyses using the Scheffe test revealed significant differences between Phase I (student) medics and Phase II (experienced) medics in the control group ( $P<.01$ ), as well as significant differences between the Phase II control group and Phase II Group 2 (experienced medics with video supplementation only) ( $P<.04$ ), i.e., the Phase II control group of experienced medics took less time to apply the tourniquet than both the novice medics and experienced peers who had watched procedural videos. Lastly, there were no significant between-group differences noted for total time taken to successfully manage the hemorrhage scenario. (See Table 5 below.)

**Table 5****Hemorrhage Scenario**

(Significant between and within group differences  
are indicated by matching superscripts =  $P < 0.05$ )

| <b>Group</b>                                | <b>Hemorrhage Number of Steps</b> | <b>Hemorrhage Total Time</b> | <b>Hemorrhage Total Time to Place Tourniquet</b> |
|---|-----------------------------------|------------------------------|--|
| <b>Phase I</b> (Novice medics)              |                                   |                              |  |
| <b>Mean</b>                                 | 8.26*(+)                          | 66.16                        | 34.75**  |
| <b>N</b>                                    | 399                               | 398                          | 395  |
| <b>Std. Deviation</b>                       | 2.41                              | 26.66                        | 13.03  |
| <b>Phase II</b> (Experienced medics)        |                                   |                              |  |
| <b>Group 1:</b> Control                     |                                   |                              |  |
| <b>Mean</b>                                 | 9.64*                             | 61.70                        | 29.47** (++)                                     |
| <b>N</b>                                    | 77                                | 76                           | 74   |
| <b>Std. Deviation</b>                       | 2.35                              | 22.12                        | 10.96  |
| <b>Phase II</b>                             |                                   |                              |  |
| <b>Group 2:</b> Video supplementation       |                                   |                              |  |
| <b>Mean</b>                                 | 10.22(+)                          | 65.06                        | 35.73 (++)                                       |
| <b>N</b>                                    | 64                                | 64                           | 62   |
| <b>Std. Deviation</b>                       | 1.77                              | 18.70                        | 12.32  |
| <b>Phase II</b>                             |                                   |                              |  |
| <b>Group 3:</b> Video and hands-on practice |                                   |                              |  |
| <b>Mean</b>                                 | 9.98                              | 65.50                        | 32.94  |
| <b>N</b>                                    | 64                                | 64                           | 63   |
| <b>Std. Deviation</b>                       | 2.24                              | 25.38                        | 12.56  |

*Pneumothorax*

ANOVA analysis was performed to determine differences in the mean number of steps, the mean time to insert a needle into the thorax at a 90-degree angle for pneumothorax decompression and the mean time to successfully complete the full tension pneumothorax scenario. There were no significant between-group differences found for mean number of steps taken to successfully complete the scenario. However, there were significant between-group differences for time to insert the needle ( $F = 4.19$ ,  $P < .01$ ). Post-hoc analyses using the Scheffe test revealed significant differences between the Phase II control group and Phase II Group 2 (video supplementation) ( $P < .01$ ), and the Phase II control group and the novice medics in Phase I ( $P < .01$ ), i.e., the Phase II control group of experienced medics required less time to insert the needle into the chest to relieve tension pneumothorax as compared to either Phase II Group 2 (videos) or the novice medics. Lastly, there was a significant between-group difference found for mean total time to successfully complete the tension pneumothorax scenario ( $F = 10.11$ ,  $P < .00$ ). Post-hoc

comparisons using Scheffe test revealed significant differences between the Phase II control group and Phase I novice medics ( $P<.00$ ); the Phase II Group 2 (video supplementation) and Phase I novice medics ( $P<.03$ ); and Phase II Group 3 (video and hands-on training) and Phase I novice medics ( $P<.00$ ). All of the experienced medics took less mean time to complete the tension pneumothorax scenario as compared to the Phase I novice group; the experienced medics who received video and hands-on supplementation took the least amount of time to complete the needle decompression scenario. (See Table 6 below.)

**Table 6**  
**Tension Pneumothorax Scenario**

*(Significant between and within group differences are indicated by matching superscripts =  $P<0.05$ )*

| <b>Group</b>                                | <b>Tension Pneumothorax Number of Steps</b> | <b>Tension Pneumothorax Total Time</b> | <b>Tension Pneumothorax Time to Insertion of 90° Needle</b> |
|---|---|--|---|
| <b>Phase I</b> (Novice medics)              |   |  |   |
| <b>Mean</b>                                 | 14.96                                       | 172.61**(++)(*)                        | 99.07(+)  |
| <b>N</b>                                    | 399   | 395                                    | 388   |
| <b>Std. Deviation</b>                       | 2.97  | 60.01                                  | 37.08   |
| <b>Phase II</b> (Experienced medics)        |   |  |   |
| <b>Group 1:</b> Control                     |   |  |   |
| <b>Mean</b>                                 | 15.08                                       | 145.34**                               | 84.78*(+)   |
| <b>N</b>                                    | 77  | 76                                     | 76  |
| <b>Std. Deviation</b>                       | 3.15  | 49.70                                  | 35.59   |
| <b>Phase II</b>                             |   |  |   |
| <b>Group 2:</b> Video supplementation       |   |  |   |
| <b>Mean</b>                                 | 15.25                                       | 150.17(*)                              | 100.82*   |
| <b>N</b>                                    | 64  | 63                                     | 62  |
| <b>Std. Deviation</b>                       | 2.86  | 41.86                                  | 30.58   |
| <b>Phase II</b>                             |   |  |   |
| <b>Group 3:</b> Video and hands-on practice |   |  |   |
| <b>Mean</b>                                 | 14.89                                       | 143.34(++)                             | 90.30   |
| <b>N</b>                                    | 64  | 64                                     | 64  |
| <b>Std. Deviation</b>                       | 2.74  | 48.14                                  | 31.19   |

### *Demographics*

Multiple regression analyses were used to predict what demographic or experience variables might explain or account for variability across the six dependent measures for both Phase I and Phase II groups (time to complete procedures and steps for each of the

three scenarios). The demographic variables used in the multiple regressions were: Army status (active duty or other), number of years serving as active duty, the number of battlefield casualties participants reported they cared for during their career and experience as a civilian EMT or medic. Results revealed that none of the four measures selected significantly predicted or accounted for variability in any of the dependent measures for either Phase I or Phase II participants.

## **DISCUSSION**

### **Airway Management:**

The findings regarding airway management indicate that novices and experienced medics without supplemental training performed the scenario using fewer steps. The significance of this finding is unclear and does not directly relate to clinically relevant performance. The phenomenon of enhanced training being associated with degraded performance is discussed in the hemorrhage control discussion section. More important is the finding that placement of the King laryngeal tube was consistently faster than the Combitube, to an extent that may be clinically important. Placement was about 23-31 seconds faster when placed by experienced medics in the control group, compared to novices and the experienced medics who had supplemental instruction. This represents the only clinically significant difference in the performance parameters that we studied. When compromised airway is present significant hypoxia is likely in 3-4 minutes under the best of circumstances and in less time with acute traumatic injuries. Faster placement times for the King LT suggest it is a preferred method and that dedicated training curriculum development to assure optimal performance is warranted. We suspect that experienced medics had used the King LT in practice and that those who were exposed to supplemental educational content were slower in placement due to modification of usual practice because of adherence to more strict insertion techniques under test conditions than actually used in their experience of patient care. This explanation is supported by the fact that the enhanced training experienced medic cohorts who placed the King LT also performed more steps than the control group. Paradoxically this suggests that refresher training may actually slow performance of critical tasks which have become routine practice for experienced medics. Further validation of this concept is required to consider any impact on refresher training paradigms. Adherence to protocolized steps may slow overall placement, but may also assure a safer procedure under non training conditions. Combitube placement appears more cumbersome, and placement takes longer than the King LT. Interestingly, the King LT was selected in a ratio of approximately 3:1 (74%) over Combitube in experienced medics and by about 54% of novices. This data suggests that experienced medics who may have had had clinical experiences with the Combitube prefer the King LT and that in general the King LT is placed more quickly.

### **Hemorrhage Control:**

Results from the hemorrhage control scenario indicate that the experienced medics utilized more steps to apply the CAT tourniquet, and overall, there were no significant differences in placement time between experienced and novice medics. The phenomenon

of experienced medics who were provided additional training (video review) taking more time and more steps to apply the CAT tourniquet is similar to that seen in other skills (airway and pneumothorax) which took more steps and longer time in some cohorts with additional training. Overall the differences identified between novice and experienced medics were negligible, suggesting that hemorrhage control skills are retained by medics following primary training. Careful consideration of retraining and refresher strategy effects on well-developed skills may be warranted to assure that refresher training does not degrade performance of skills that may be developed at full mastery level of unconscious competence. We observed only minor degradation of performance associated with enhanced training, in a simple scenario, and outside of the range of clinically relevant impact. Further study is warranted, with no specific implications for current training or retraining methods.

#### Pneumothorax:

Placement of a decompression needle to relieve pneumothorax was accomplished with the same number of steps in both experienced and novice medics. However the total scenario time was faster and performance within the established standard was uniformly met for experienced medics in all training groups compared to novices. This is an expected finding and validates that this skill is retained following primary combat medic training. Within the experienced medic group we again see that there is some degradation of performance in the experienced medics who received additional training taking longer to place a decompression needle than the control group, wherein the fastest placement times were observed. Overall scenario completion time was fastest in the group that had enhanced training with video and simulation practice before testing. The needle decompression critical skill scenario appears to align best with our hypotheses that experienced medics will perform skills more rapidly and effectively than novices, that enhanced training will increase performance.

#### *Conclusions;*

Over 80% of the experienced medic cohort had more than 6 years of Army experience. In 2009-10 this cohort represented a group in whom 45% that self-reported having provided care for more than 25 combat casualties. This group contrasts with the novice medic group, of which > 92% had been in the Army for <1 year, and >93% reported providing care for <10 combat casualties. These demographically distinct cohorts allowed analysis of a broad range of demographic factors, none of which correlated with performance of specific lifesaving combat medic procedures for treatment of preventable lethal battlefield injuries. We conclude that selection of medics for tailored training or retraining regimes based on demographic profiling, such as combat experience, clinical experience and age is not feasible. It is unlikely that further evaluation of this is likely to yield substantial reliable information that could allow curtailment of training to optimize resource utilization or tailor training to an more appropriately matched skill level for combat medics in either initial or refresher training.

As expected, for all scenarios the experienced CFM performed procedures in less total time than did novice medics. We have generally confirmed that skills degradation by our measures is not a significant problem for combat medics. We were unable to identify individual characteristics which could discriminate along any spectrum of performance for any individual or cohort. However an unexpected finding was that for multiple subsets of procedures, novice completion times on average were slightly faster than for experienced medics who had received supplemental instructional reviews with either videos or simulation-based rehearsals, and control group experienced medics performed better than those who had received supplemental training. This phenomenon was seen in multiple scenarios and did not elevate in any single skill performance analysis to the range of performance degradation that would be clinically significant. Further investigation of this phenomenon is warranted and consideration of training paradigms should include analysis for this effect. Our research design is susceptible to a Hawthorne effect, whereby subjects improve or modify an aspect of their behavior being experimentally measured simply in response to the fact that they are being studied.<sup>9</sup> Modification of behavior may include adherence to recently experienced protocols, or incorporation of extra steps resulting in degraded time delineated performance parameter. It is unclear if this is responsible for the observations in this study.

Alternatively, the observations could be simply due to skewing effects from the smaller sample size of the experienced group and subsets. Unexpected findings could have also resulted from the fact that the experienced medics were able to visit the testing station at the beginning of their two-week training session, whereas all novice medics were tested toward the end of their intensive and standardized 14-week program.

Two other unexpected findings were that none of the novice medics on average completed the tension pneumothorax scenario in the allotted time of 155 seconds, and only the control group of experienced medics was able to complete the airway scenario in the allotted 180 seconds. This study was not powered or designed to establish performance standards for combat medic training. However the time based performance parameters observed in this large cohort could inform prospective development of performance standards going forward.

Currently, DCMT is using human-patient simulators as an educational tool for CFM trainees, not as a system-wide assessment tool. The present study validates that high fidelity simulators with sensor technologies can be used not only to evaluate individual performance outcomes but also to aggregate results that can produce “lessons learned” for curriculum management and systematic approaches to medical instruction. The power of aggregating performance outcomes for analysis may be especially useful as the

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<sup>9</sup>See McCarney R, Warner J, Iliffe S, van Haselen R, Griffin M, Fisher P. The Hawthorne Effect: a randomised, controlled trial. *BMC Medical Research Methodology* 2007, 7:30; Mayo E. The human problems of an industrial civilization. Volume 3. 2nd edition. New York, MacMillan; 1993:53-73; and Roethlisberger FJ, Dickson WJ. *Management and the Worker* Cambridge, Mass., Harvard University Press; 1939.



services consolidate training, and perhaps for establishment of competency standards based on population performance parameters.

The study offered a snapshot of novice and experienced combat medic performance. Future studies would benefit from refinements that take into account the clinical significance of equipment choice and observed differences in time to complete procedures and the organizational significance of some training approaches. For example, from a patient care standpoint, there may not be an important difference between 61 and 66 seconds to perform a hemorrhage control procedure. Taking another perspective, from an organizational standpoint, the use of simulators to confirm competence in experienced medics could save valuable re-training resources and assure that medic training is competency based.